



Matching food service products to consumer demands through product development alliances and modularisation

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Matching food service products to consumer
demands through product development
alliances and modularisation

Johanne Rønnow Olsen

PhD Thesis

November 2008

National Food Institute

Technical University of Denmark

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PREFACE

If consumers have a whole meal in mind when shopping or dining out, then why should not the food producers have the same mental picture when developing new products? It is paradoxical if producers are focusing their efforts on developing and producing single components, when, in reality, their products are typically combined with others before consumption and evaluated by the consumer in this context. More meals are being consumed out of home, and there seems to be a need for food producers to improve the quality and variation of their product offerings if they want to occupy a significant position in this emerging market. These observations motivated this industrial PhD project which aims to explore avenues for creating a win-win situation for consumers and producers by better matching demand and supply on the food service market¹.

The research idea sprang from practice observations. This is, indeed, very much in the spirit of the industrial PhD, which is supposed to promote the applicability of research findings in a business context. It is also in line with a research tradition within natural sciences that takes its starting point in real-life observations and problems. Although food products and the quality of these have been central to this research, originating in food technology, it has not been the only focus. The thesis also takes into account aspects of producers and processes involved. The research process therefore adopts a multidisciplinary frame, which has greatly influenced the choices of theory and methodology, and it is characterised by a dynamic interplay between practice and theory.

The work with this research project has been challenging, interesting - at times also frustrating – and continually relevant in the light of ongoing developments in the food industry and on the food service market in Denmark. The writing of this dissertation has been especially rewarding, putting all the small parts into a context, and supplying a feasible and relevant solution to the originally posed challenges.

¹ Sale of food and beverages prepared and bought outside the home (IFAU, 2003).

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This research could never have been accomplished without the commitment and enthusiasm of my advisors Alan Friis, Torben Bo Toft Christensen and Hanne Harmsen, who have all offered important contributions to this research. Their complementary competences lie at the heart of the multidisciplinary balance between theory and practice in our discussions, and have been instrumental in creating an excellent atmosphere and rewarding research process.

The research approach has been atypical to each of the three working environments of which I have been privileged to be part, and I would like to thank my colleagues at the department Project and Development (the Danish Agricultural Council, where I have been employed), in the research group Food Production Engineering (DTU Food, The Technical University of Denmark) and at the research centre MAPP (Aarhus School of Business, Aarhus University) for their open-mindedness and willingness to embrace, discuss, and generate new ideas. I would especially like to thank my PhD-colleague Eva Høy Engelund from DTU Food for valuable input and back-up in our discussions on research topics and processes. Furthermore, food technologist Nancy Kjørbæk has been an invaluable help in relation to the visual quality of the figures presented in the dissertation.

Three scientific papers have been published in relation to the research project, one of them with co-author Margit Dall Aaslyng from the Danish Meat Research Institute. I am most grateful to Margit for offering inspiration, research experience and results in developing the concept of meal modularisation. The two other papers are based on qualitative input from informants in the Danish food industry, to whom I also owe thanks for their openness.

Last, but not least, my deep gratitude goes to my friends and family for supporting me and keeping me grounded and happy, especially the three most important people in my life – my husband Jacob and my daughters Olivia and Nicoline, who light up everything with a smile.

Partners and funding

The research has been carried out at the Danish Agricultural Council, the Technical University of Denmark, and Aarhus School of Business, University of Aarhus, from May 2004 to October 2008 (including two periods of maternity leave).

Funding of the project has been kindly provided by the Danish Agricultural Council, the Danish Ministry of Science, Technology and Innovation, Norma & Frode S. Jacobsens Foundation, The Danish Meat Research Institute and Agrova Food.

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Johanne Rønnow Olsen

October 30th, 2008

RESUME

Et stigende antal måltider indtages uden for hjemmet, og dette udgør et interessant marked for fødevareproducenter. Det kan dog være en forholdsvis stor udfordring at opfylde varierende og skærpede forbrugerkrav til fx kvalitet, især fordi producenter typisk ikke er involverede i sammensætningen af det endelige måltid og derfor ikke har mulighed for at kontrollere alle de processer og interaktioner med andre måltidskomponenter, som deres produkt bliver udsat for. I dette projekt foreslås, at samarbejde mellem fødevareproducenter om produktudvikling (produktudviklingsalliancer) i relation til måltidsløsninger kan forbedre kvaliteten af det færdige produkt (som den opfattes af forbrugeren), samt at sådanne relationer mellem virksomheder kan understøttes af modularisering – en systematisk tilgang til at oversætte forbrugerkrav til produktspecifikationer. Arbejdshypotesen udforskes gennem fire forskningsspørgsmål, hvoraf de tre første relaterer sig til et af hovedområderne kvalitet, produktudviklingsalliancer og modularisering (herunder publicerede videnskabelige artikler inden for disse områder) og det fjerde understøtter en samlet diskussion og perspektivering af forskningsresultaterne.

Forskningsarbejdet har genereret de nedenfor beskrevne hovedkonklusioner. En vigtig forudsætning for opfyldelse af forbrugerkrav ift. kvalitet af et produkt er, at producenten opstiller kvalitetsmål, der er relevante for forbrugerne. Derudover skal de kompetencer, der anvendes i produktudvikling og produktion stemme overens med disse mål. Dette er en kompleks opgave i relation til måltidsløsninger, fordi der er adskillige fødevareproducenter involveret i processen med ansvar for separate dele af måltidet, og de har alle deres egne prioriteter i forhold til kvalitet og produktudvikling. Derimod baserer forbrugeren primært sin kvalitetsvurdering på et enkelt produkt – den samlede måltidsløsning. Kvalitetscyklussen introduceres som et konceptuelt værktøj, der illustrerer disse udfordringer samt potentialet i produktudviklingsalliancer og modularisering som mediatorer i denne forbindelse. Produktudviklingsalliancer kan facilitere koordination af mål for kvaliteten af både måltidsløsningen og dens komponenter mellem fødevareproducenter. Modularisering kan sikre egnetheden og operationalisering af disse mål i forhold til forbrugerkrav, hvilket understøtter relevansen af måltidsløsningens kvalitet. Fra en fødevareproducents perspektiv er en vigtig synergieffekt ”mass customisation” – evnen til at kombinere tilpasning til slutbrugerbehov med stordriftsfordele. Endvidere er muligheden for at skabe produkter, der er sværere

at efterligne, samtidig med at der fokuseres på kernekompetencer, en motivationsfaktor for at implementere produktudviklingsalliancer, støttet af modularisering. Fremtiden for virksomheder, der vælger denne fremgangsmåde, afhænger af dels 1) efterspørgslen efter varierede måltidsløsninger af høj kvalitet og 2) i hvor høj grad det er muligt for fødevarerproducenterne at påvirke kvaliteten af den samlede måltidsløsning.

Det empiriske arbejde er udført i Danmark og er centreret omkring semistrukturerede interviews om produktudviklingssamarbejde, "reversed laddering"-sessioner om kvalitet med produktudviklingsansvarlige i fødevarerindustrien, samt et case studie af en produktudviklingsalliance. Dette er suppleret med en spørgeskemaundersøgelse blandt en større gruppe produktudviklingsansvarlige i fødevarerindustrien med hovedtemaerne fødevaretendenser, måltidsløsninger og produktudviklingsalliancer, samt data fra sensoriske analyser, der fokuserer på interaktioner mellem måltidskomponenter¹. Udover den tidligere nævnte kvalitetscyklus har forskningen genereret de nedenfor listede værktøjer, der er relevante både ledelses- og forskningsmæssigt:

- En typologi for produktudviklingsalliancer, der beskriver sammenhængen mellem slutproduktets kompleksitet og graden af samarbejde mellem virksomheder om produktudvikling. Dette kan fx danne basis for strategidiskussioner i forhold til en virksomheds nuværende position og fremtidige mål.
- En ramme for produktudviklingsalliancer, der beskriver faktorer af betydning for dannelse og succes af denne slags samarbejde.
- En tilgang til måltidssammensætning, der eksemplificerer potentialet i at anvende modularisering i forbindelse med fødevarer og herunder måltidsløsninger.

Forskningsresultaterne har bidraget til videnbasen om produktudvikling i fødevarerindustrien, især i forhold til kvalitet, produktudviklingsalliancer og modularisering, og udfylder flere huller i litteraturen. Fremtidig forskning bør fokusere på yderligere at dokumentere anvendeligheden af de udviklede værktøjer, især i relation til produktudviklingsalliancer i fødevarerindustrien med fokus på måltidsløsninger.

¹ Udført på Slagteriernes Forskningsinstitut

SUMMARY

An increasing number of meals are being consumed outside the home, and a new, interesting market for food producers are therefore emerging. However, meeting consumers' demands, among others for quality, can represent a challenge, especially because producers are typically not involved in the composition of meal solutions and, therefore cannot control all processing steps and interactions with other meal components. In this project, it is proposed that cooperation between food producers on product development (product development alliances) in relation to meal solutions can improve the quality of the end product (as perceived by the consumer) and that such interorganisational activities can be further supported by modularisation – a systematic approach to translating consumer requirements into product specifications. The working hypothesis is explored through four research questions. The first three research questions each relates to one of the main research areas quality, product development alliances and modularisation, and are partially answered through published, peer-reviewed papers. The final research question facilitates a discussion of the collective findings and perspectives.

The research has generated the main conclusions described below. One important precursor for meal solution quality is that the producer sets product quality goals relevant to the consumer. Furthermore, the competences applied in product development and production have to be consistent with these goals. In the case of meal solutions, this is a complex task, because there are several food producers involved, who are responsible for different parts of the product, and who all have their own priorities in relation to quality and product development. However, the consumer bases his quality evaluation primarily only on the end product – the meal solution. The quality cycle is introduced as a conceptual tool to illustrate the challenges described above as well as the potential of product development alliances and modularisation as mediators within this frame. Product development alliances can facilitate coordination of quality goals for the meal solution and its components among food producers. Modularisation can ensure the appropriateness and operationalisation of these goals in relation to consumers' requirements, thereby supporting the relevance of meal solution quality. From a food producer point-of-view, an important synergy effect is mass customisation – the ability to combine customisation to end-user needs with economies of scale. Furthermore, the ability to create more inimitable products while still

focusing on core competences spur the implementation of product development alliances, supported by modularisation. Managerial guidelines for implementation have been developed. It is concluded that the likeliness that companies will adopt this approach depends on 1) the demand for high quality and varied meal solutions and on 2) how much of meal solution quality it is possible for food producers to influence.

The empirical work has been performed in Denmark and draws on semi-structured interviews and reversed laddering sessions with product development managers in the food industry, as well as a case study of a product development alliance. This is supplemented by a questionnaire distributed to a larger group of product development managers (with the main themes food trends, meal solutions and product development alliances), as well as data from sensory studies of interactions between meal components¹. Apart from the quality cycle mentioned above, the research has generated the tools listed below to be applied both in a managerial and research context:

- A typology for product development alliances that describes the links between and the complexity of the end product and partner interaction in new product development. The tool can form the basis for strategy discussions on a company's current position and future goals.
- A framework for product development alliances in the food industry that describes factors of importance to the formation and success of such forms of cooperation.
- The Meal Composition Approach which exemplifies the potential of applying modularisation in relation to food products and, more specifically, meal solutions.

The results of this research contribute to the knowledge base on product development in the food industry, mainly regarding quality, product development alliances and modularisation, and fill several gaps in the literature. Future research should focus on further documenting the applicability of the developed tools within the context of product development alliances in the food industry with a particular focus on meal solutions.

¹ Performed at the Danish Meat Research Institute

GLOSSARY OF TERMS

- **Food producer** - food industry actor supplying processed and / or packaged foods
- **Meal customisation** - the customisation of meal solutions to a wide range of end-user needs by combining efficiently produced components.
- **Meal development alliance** – inter-organisational arrangements in which food producers jointly develop meal solutions based on components that will be marketed or sold together
- **Meal modularisation** - composing a meal solution from several components on the basis of end-user requirements, integrating functionality of individual components as well as processing conditions and potential component interactions
- **Meal solution** - main course or pre-assembled main course components bought outside the home.

1 RESEARCH APPROACH

This chapter will explore the research approach on which the dissertation is based.

1.1 Background

On the way home from work, in school, in the work-place canteen, when travelling, in the hospital, when enjoying a night out and in many other situations - when we do not have the time or do not want to cook a meal from “scratch”, we more and more often choose to buy meals outside the home. However, producing quality meal solutions appropriate to these situations and satisfying consumers’ quality demands represents a challenge to industry.

This project aims at assisting food producers¹ in meeting this challenge by empowering them to play a positive and proactive role in the process of matching demands and products.

The demand for more complex and higher quality food products (meal solutions) has been increasing in recent years (Euromonitor International, 2006; USDA 2008). This trend has emerged as a consequence of consumers having less time, more money, being more positive towards convenience products, and becoming more conscious of the product quality they demand with regards to e.g. taste, health and convenience. Naturally, producers want their products to generate income by letting them be a part of meal solutions, which are attractive to the market, and it seems straightforward to achieve this goal by simply delivering what the consumer wants! However, many factors, some beyond the control of the producers, actually make this task rather complex. Meal solutions consist of several components, the production and development of which often take place in parallel and independently, and furthermore isolated from meal composition, assembly, and further processing (see Figure 1.1). The components have a long road to travel in the production chain from producer to consumer and a somewhat uncertain destination to reach in the end product - the meal solution.

An important precondition of meal solution quality is that the producer’s quality goals for components and meals are relevant to the consumer. This should lie at the heart of any

¹ Food industry actor supplying processed and / or packaged foods

product development and production, but demands a market-oriented approach from companies in an industry, which is typically known to be more product and process-oriented (Grunert et al., 1997b). Furthermore, even if this is fulfilled, the product leaving the factory does not always have the intended quality in the final meal, either because it has been treated suboptimally during storage or further processing, or because it interacts in undesirable ways with other meal components. This can result in dissatisfaction among consumers, who do not feel that their demands are being met, and therefore do not choose the meal (again), and their reaction will influence the business of all food producers involved. This, it may be favourable to both producers and consumers to rethink this chain.

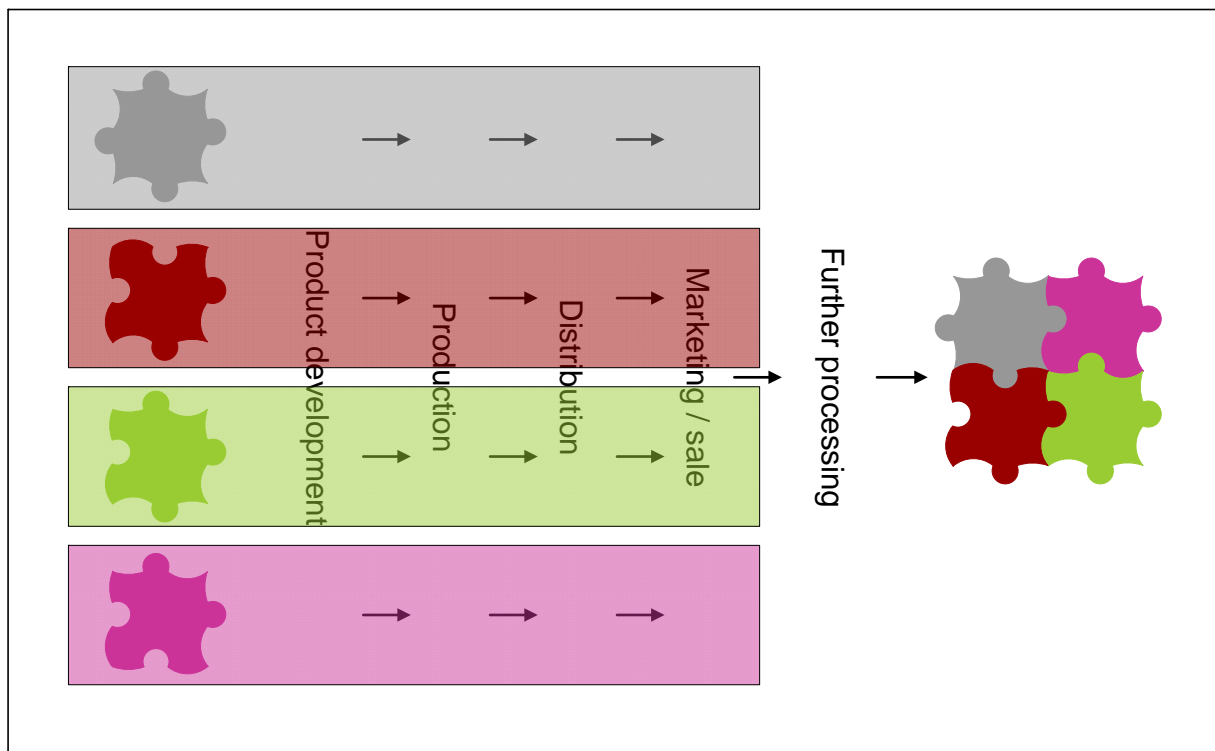


Figure 1.1 Typical production chain for meal solutions.

The challenges described above can potentially be met through more and better cooperation between producers, developing, optimising and coordinating products and processes, thereby improving the consumer-perceived quality of meal solutions. Food producers possess important knowledge in relation to interactions, further processing, storage conditions, markets, etc., which can improve the basis upon which meal composition is performed and guidelines for handling of components and meals developed.

Thus, within the context of meal solution development and quality, there seems to be a promising potential for improving end product quality through inter-organisational cooperation between food producers, specifically through creation of product development alliances. However, cooperation of any kind is not always a simple endeavour, and one could argue that the complexity could be reduced by systematically supporting development activities. As meal solutions are component-based products, modularisation may act as such a facilitator (as it does in other industries related to products such as computers and automobiles). Modularisation does not necessarily have to be implemented within the framework of an alliance and it is expected that it may, in general, contribute to quality optimisation of food products. However, the combination of product development alliances and modularisation is proposed to enjoy several advantages owing to the synergy achieved, e.g. of mass customisation, to both consumers and producers.

1.2 Research base and dissertation structure

The following working hypotheses emanate from the above review of challenges facing today's food production industry and the potential means of meeting them:

WORKING HYPOTHESIS

Quality of meal solutions can be improved by food producers entering into product development alliances and applying modularisation

The key concepts in the working hypothesis are quality, product development alliances and modularisation – within the context of meal solutions. These concepts have guided the research questions:

- **Research question A:** How is food quality understood and how is it linked to product development in the context of meal solutions?
- **Research question B:** Can product development alliances facilitate quality improvements of meal solutions, and how can they be initiated and succeed?
- **Research question C:** Can modularisation facilitate quality improvements of meal solutions, and, if so, how?

- **Research question D:** What are the potential effects on meal solution quality of combining product development alliances and modularisation?

The structure of the dissertation is presented in Figure 1.2. The dissertation includes three original papers published in peer-reviewed scientific journals as part of the research process:

- **Paper A:** Olsen, Harmsen & Friis (2007): *Linking quality goals and product development competences*, Food Quality and Preference 19, 33-42
- **Paper B:** Olsen, Harmsen & Friis (2008): *Product development Alliances – factors influencing formation and success*, British Food Journal 110, 430-443
- **Paper C:** Olsen & Aaslyng (2007): *The Meal Composition Approach*, Journal of Foodservice 18, 133-144

In the dissertation they will be referred to as paper A, B and C.

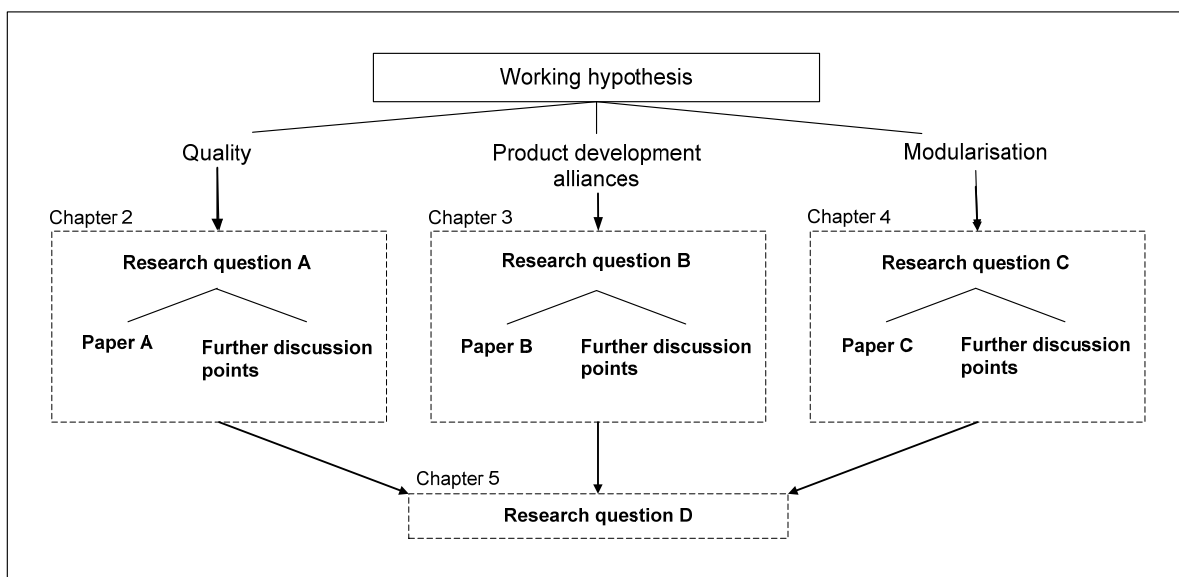


Figure 1.2. Structure of Chapters 2-5 which centre on the three key research areas

As illustrated, chapters two, three and four are dedicated to research questions A-C, corresponding to the three central concepts in the working hypothesis. Each chapter is structured around a paper, starting out with an introduction to the subject of the chapter, followed by the background and research needs motivating the paper. Then, further discussion points are introduced in relation to the research question of the chapter and manage-

rial and research implications are discussed. Centred on research question D, Chapter five takes a broader view. A basis for a synthesis of research findings is created, making it possible to revisit the working hypothesis and evaluate the feasibility of the results and the over-all research contribution of the dissertation.

1.3 *The research process*

It appears from the working hypothesis that the main research areas within the frame of meal solutions, are quality, product development alliances and modularisation – each of which is rooted in its own scientific tradition of food technology, management and engineering. Thus, the work presented here is multidisciplinary by nature, combining theory and methods from the natural and social sciences. The strength of such a multidisciplinary approach is that it allows the researcher to expand beyond traditional scientific borders of individual disciplines and to provide a more thorough discussion of approaches to real-life challenges facing the actors in the food industry. Yet it should also be borne in mind that given the breadth of the research domain covered, some areas will not be explored in depth and will be subject to further research.

Coming from a food technology background, it soon became obvious that a broader mindset was needed. Organisations cannot be studied in the same way as food products, but have to be studied in their own environment and results analysed with the aim of obtaining general conclusions relevant to the group of informants and to some extent also to their companies. Indications of how findings apply in a broader context, at e.g. industry or alliance level, can also be described. The research has been both inductive (from practice to theory) and deductive (from theory to practice), and literature and empirical research have mutually guided choices during the process. See Figure 1.3 for an overview of the research process.

The case study was performed in the beginning of the project, and it affected the research questions as did the literature studies of the main theories. Further empirical data was collected and the data analysis was supplemented by theory. Final empirical results were obtained by means of a questionnaire survey. Furthermore, results from sensory analysis

performed in a concurrent research project² contributed to the results as far as modularisation of food products was concerned (paper C). The central conceptual tool, the quality cycle, is theory-based, but has been developed further on the basis of research results. It is used throughout the dissertation to illustrate the theoretical perspectives adopted. The research also generated other output of which the most important are a framework of factors important to the initiation and success of product development alliances, a typology of product development alliances, and the Meal Composition Approach (based on modularisation principles). Managerial guidelines for implementation of product development alliances and modularisation have also been developed.

As seen in Figure 1.3, a wide range of theories were included. The multidisciplinary approach also influenced the methodological choices. The unit of analysis was not only a physical product to be studied, but individuals in the context of their organisations as well as forms of between organisations. Furthermore, a variable amount of literature was available within each of the chosen research arenas, which opened up for the use of both exploratory, qualitative and quantitative methods. This is further described in section 1.5. The research questions were presented earlier and the output will be presented in the following chapters.

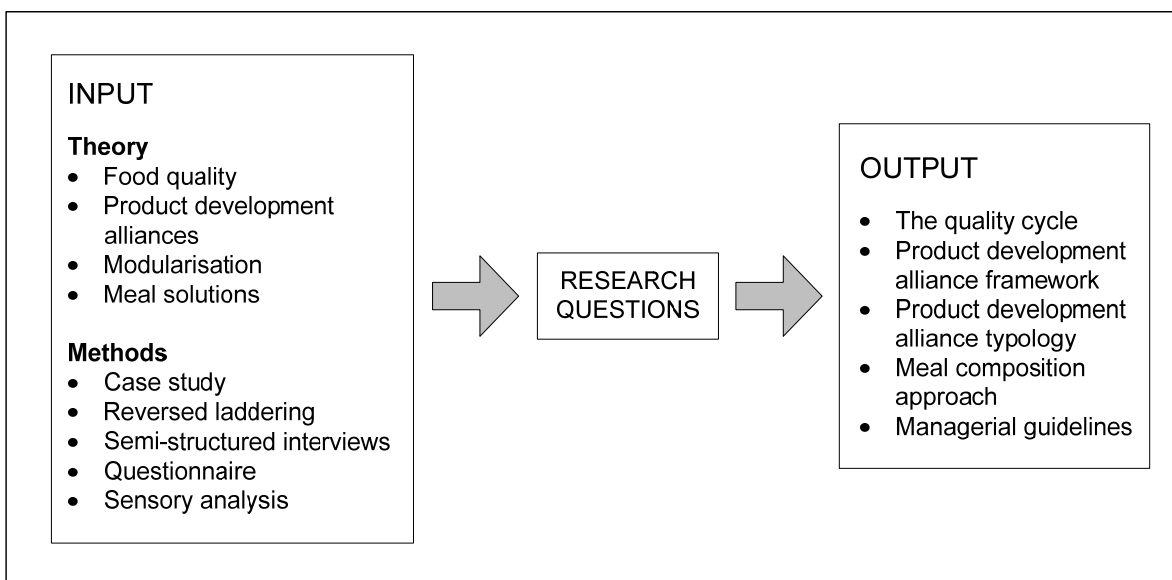


Figure 1.3. The research process.

² “Meat as a part of a meal”, at the Danish Meat Research Institute

1.4 Theoretical frame

The theoretical frame is presented, see Figure 1.4. As mentioned above, the approach is practice-driven and multidisciplinary. Within each research area, the ambition is to identify elements that are critical to the research questions whether these elements are constitutive or more peripheral elements of the theory addressed. Figure 1.4 and the below text is divided according to the three main research areas as well as the context of meal solutions

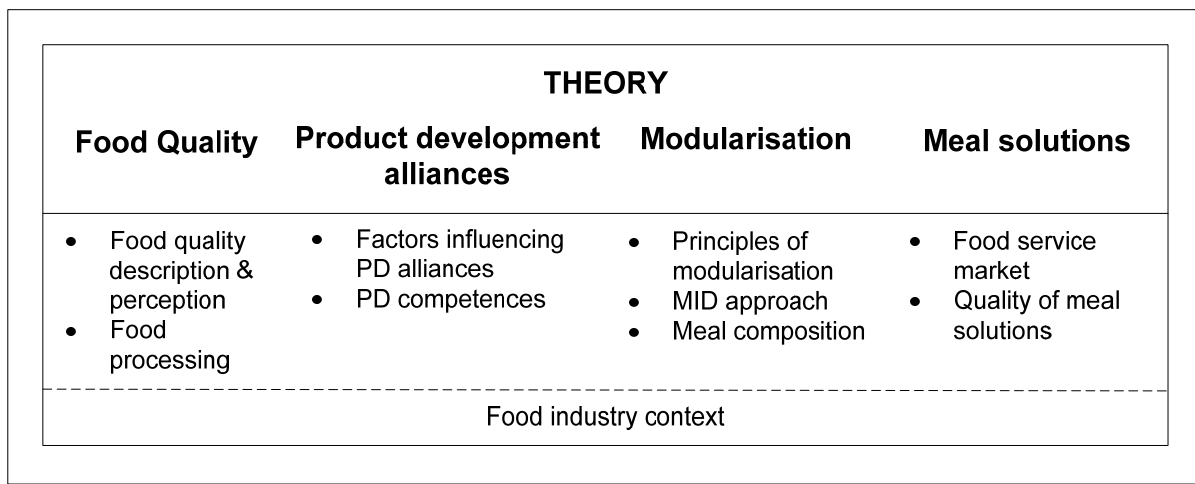


Figure 1.4. Theoretical frame. Main theoretical themes. The food industry context is relevant to all research areas. PD: product development, MID: Module Identification (O'Grady, 1999).

1.4.1 Food quality

In this dissertation, food quality is generally understood from the consumer's point of view. *Food quality* is one of the most important determinants of food product choice (Grunert et al., 1996). Thus, product development should result in products with quality characteristics that satisfy consumers' demands. However, quality is a concept that contains many different elements of both objective and subjective nature, which makes it necessary for the producer to be acutely aware of the nature of specific consumer demands and how these can be fulfilled. The project focuses on theories of *food quality description and perception*. Food quality is, of course, significantly influenced by *food processing*.

1.4.2 Product development alliances

The research attempts to uncover whether *product development alliances* - not strategic alliances in general - in the food industry have potentially positive outcomes and how the realization of these outcomes is best facilitated. The practicalities of implementing and maintaining such relationships do not fall within the scope of this project. Issues such as transaction cost economics, including governance and contractual issues in alliances, and optimisation of knowledge sharing are therefore not included in the theoretical frame. Another theoretical avenue, which was originally also an economic theory of the firm, the resource-based view, has been adapted to alliances by Eisenhardt & Schoonhoven (1996). Their definition of product development alliances is applied, as it makes sense to think of the involved companies as bringing complementary resources to the product development alliance.

Product development alliances between food companies originating in different branches of the industry, which are, in principle, non-competitors, can be characterised as horizontal. Although literature on horizontal cooperation within an industry does exist, it has only in a few cases been relevant to this research, as it often describes industry networks, where competitors develop e.g. a standard-setting technology together (Axelrod et al., 1995), which is typically not consumer or end-product focused. Furthermore, because the involved companies have similar (not complementary) competencies, a competitive environment and a very loose network structure results. The project focuses on the potential outcomes of product development alliances on a food industry / alliance level. Thus, literature on the additional consequences that activities within this frame can have on specific firms and e.g. their relationship with other actors in their network (industrial marketing and purchasing) is not included.

Literature considering *factors* influencing product development alliances, such as motivations, risks, etc., is important to this research because it points to potential synergy effects, barriers and outcome of product development alliances. Literature within this field hence offers input to an evaluation of the future for such activities in the food industry.

Product development management must be expected to be complicated further by the involvement of several partners in an alliance (Gerwin & Ferris, 2004). However, this is an issue which is more closely connected to alliance operations than to the subject of the present thesis, and it is therefore not included in the theoretical frame. Product development managers, however, are relevant when evaluating the potential of product development alliances in the food industry, because they are important to the expectations and attitudes a company forms about these kinds of relationships. *Product development competences* are interrelated with product development management in that this issue also influences attitudes, and it makes up a part of the resources that a company brings to an alliance. Competences / capabilities is a large theoretical area in itself. It relates to more general company issues, not just product development, and this issue therefore falls outside the project scope.

1.4.3 Modularisation

Modularisation principles have been chosen as a focus area in the project, because in other industries this area has shown to support the development and production of complex products with components (modules) stemming from different producers, (Baldwin & Clark, 1997; Arnheiter & Herren, 2006). The principles of modularisation will therefore be applied to product development of meal solutions to analyse whether this approach is a useful tool for food producers, e.g. when considering possible interactions between components and when seeking to fulfil quality criteria for the meal as such. The *MID approach* (O'Grady 1999) will be used as an inspiration for product development of a modularised product. However, modularisation is most often described in vertical relationships, where it is used e.g. in automobile production for design and sub-task division of the production and assembly process. This also raises new issues, such as sourcing of modules and / or processes (Doran, 2003). As this project is concerned with product development alliances where the sourcing is more or less given beforehand (in relation to the resources / products which each partner brings to the alliance), and where there is not necessarily a focal firm / customer controlling the modularisation process, this specific aspect is not included in the theoretical frame. Modularisation of meal solutions, although more complex than most other food products, will not result in end products as complex component-wise as e.g. an automobile. On the other hand, meal solution modularisation holds new challenges

such as multiple potential combinations of modules as well as product changes caused by storage and processing. It is therefore relevant to consider how others have approached the task of *meal composition* and how to describe module characteristics, e.g. in relation to the ability to combine modules that react similarly to further processing steps, with a view to fulfilling quality goals for the resulting meal solution.

1.4.4 Meal solutions

The research is performed within the context of *meal solutions*, and the *quality* of these solutions is a key theme. Furthermore, it is important to be able to describe the development in the *food service market* (including related consumer needs) as it in this dissertation is argued to be an important motivating factor for food producers to consider entering into product development alliances.

1.4.5 Food industry context

The food industry has several characteristics which potentially influence the future of product development alliances, e.g. tradition, market development, quality focus and consumer behaviour (Avermaete et al. 2004; Grunert et al., 1996; Baker, 2007). Other factors, such as product development activity (or lack of the same) and strategic orientation are also important for understanding the context of the research. Some of these are specific for the food industry and some can be found in literature at a more general level concerning what is commonly considered low-tech sectors, such as chemical industries, automobile industries, etc. (Hagedoorn, 1993), which furthermore can be a source of inspiration. Relevant literature concerning *food industry context* is therefore included.

The theoretical frame, which has formed the basis for the research activities, is multifaceted, but as described closely connected to the research questions and working hypothesis.

1.5 Methodology

The methods applied in the project for collecting empirical data have primarily been qualitative. The focus has been on semi-structured interviews and reversed laddering, supplemented by a case study and a questionnaire. Furthermore, previously unpublished data

from sensory analyses based on studies performed by the Danish Meat Research Institute has been included. The methodologies focus on separate units of analysis, which have been linked in the data analysis. This ensures a broad view of the interactions between product, company and product development alliance in relation to quality of meal solutions. Table 1.1 shows the unit of analysis and the primary interlinked entity, when analysing the data in the research context.

	Product	Company / managers	Product development alliance
Case study		(x)	x
Semi-structured interviews		x	(x)
Reversed laddering	(x)	x	
Questionnaire survey	x	(x)	
Sensory analysis	x		
Desk research	x	x	x

Table 1.1. Unit of analysis (marked with x) and primary interlinked entities in results (marked with (x))

The choice of primarily explorative, qualitative methods to address research questions A and B was due to the lack of literature about the related core elements in the research - product development alliances and managerial quality goals in the food industry. An introductory *case study* was chosen to obtain practical insight into a product development alliance in the food industry developing a meal solution. This case study was very valuable in shaping the research approach. *Semi-structured interviews* gave a larger group of informants than in the case study an opportunity to express their view of product development in alliances at a more general level. The number of product development alliances in general and related to meal solutions in particular was very limited. Such activities are still in their infancy in the Danish food industry, and therefore strategic rather than practical was obtainable from managers. It was found relevant to uncover managerial attitudes towards product quality and the link between product quality and product development, on the theory-based assumption that this would also affect the actual end-products. *Reversed lad-*

dering was applied to systematically uncover quality goals and the underlying links to product development competences. Building on the qualitative results, a *questionnaire survey* in the Danish food industry was performed. Although the response rate was rather low, trends for food in general and meal solution in particular were identified, which could be subject to further research.

Literature on modularisation (supporting research question C) in the food industry was also scarce, but it was decided that this issue could not be researched directly because of the lack of knowledge of this concept among managers. Modularisation was instead considered theoretically in relation to qualitative data from *sensory analyses*³ which thereby provided a basis for evaluating the potential effects of modularisation on product quality. The empirical data collection was backed by desk research within all areas.

1.6 Research contribution

The theoretical and empirical research areas all contribute to an understanding of how quality improvements of meal solutions can be facilitated by product development alliances and modularisation. The present thesis contributes to research, primarily by:

- Linking quality goals and product development competencies
- Applying modularisation in the food industry
- Developing a framework for product development alliances in the food industry
- Linking modularisation, product development alliances and food quality

Over-all, the research contribution is expected to be:

RESEARCH CONTRIBUTION

To contribute to the knowledge base on product development in the food industry, mainly regarding quality, product development alliances and modularisation.

³ Performed at the Danish Meat Research Institute by Margit Dall Aaslyng, Mari Ann Tørngren, and colleagues.

2 QUALITY AND PRODUCT DEVELOPMENT OF MEAL SOLUTIONS

In this chapter food quality and its complexity will be discussed and the conceptual framework, “the quality cycle”, will be introduced. Paper A considers managerial quality goals and their link to product development competences. Then, quality will be placed in a meal solution perspective and challenges of product development in this context will be discussed. The main research question posed in this chapter is:

RQA: How is food quality understood and how is it linked to product development in the context of meal solutions?

2.1 Dimensions of food quality perception

Quality is a main determinant of product choice in relation to food products (Grunert et al., 1996). As quality is important for consumer choice, it is also important for the competitive advantage of producers, ensuring the market position in relation to competitors. The food industry can be characterised as a consumer goods industry with quick product turn-over, immediate consumer product evaluation and a strong producer and consumer focus on quality (Avermaete et al., 2004; Grunert et al., 1997a). The industry is also described as a process-oriented industry (Grunert et al., 1997b), with a low R&D expenditure (Grunert et al., 1997a, Baker, 2007) and generation of only few radical product innovations (Costa and Jongen, 2006). The scope for product differentiation is therefore limited and meeting quality demands is crucial for establishing a competitive position – *“...the quest for better quality has become one of the most important strategic priorities confronting the food industry”* (Steenkamp & van Trijp, 1996, p. 196).

Quality – as perceived by the end user - should be a major driver for product development activities in the food industry, and it generates the products on which end user evaluation – and choice – is ultimately based. Product development managers seem to be aware of this challenge because among 39 managers in the Danish food industry asked in the questionnaire to describe the vision for their own company in three words, 29 mention quality⁷. The challenge of working with quality, however, is that it has both objective and subjective

⁷ See appendix A

dimensions and has different meanings to different consumers, to the producers, retailers, etc. and that it does not have a “*fixed position in time and space*” (Bremner, 2000, p. 83). The literature on quality optimisation of products is abundant and focuses on different aspects, ranging from nutritional composition and sensory characteristics to food safety and price and contextual factors in the eating situation. For example, the Total Food Quality Model (Grunert et al., 1996) illustrates the complexity of consumer quality perceptions which are, based on numerous quality cues prior to purchase, and are also shaped by the consumer's experience with the product after purchase. Specifically for consumer quality demands, Brunsø et al (2002) concluded that four quality dimensions are particularly important: health, taste, process characteristics (organic production, animal welfare etc.) and convenience. Recent market studies and research support the focus on taste, health and convenience, and adds freshness (ACNielsen, 2006), variation and price (Costa et al. 2007; Candel, 2001)

Thus, quality optimisation is complex, because of the abundance and constant changes in consumer demands and the intangible nature of some of the quality characteristics. Furthermore, there are potential discrepancies between what product developers and end users find important based on studies of the different types of knowledge about food in these two groups (Sijtsema et al., 2004). Thus, it is a challenge, but also crucial for food producers to work consciously with developing and producing products of a relevant quality, i.e. possessing specific characteristics fulfilling end user demands in the chosen segment(s) and situation(s) for the chosen product(s). On this note, the findings of Waller & Ahire (1996) of a positive link between (purchasing) manager perceived product quality and manager perceived customer-view of product quality in several hundred firms in a single industry (metal products) is encouraging – if the managers perceive their company's products to be of a higher quality, they also expect their customers to do so and can therefore be motivated to focus on this area.

Product development managers are key players in relation to end product quality, as their own beliefs about what good quality is and how it should be obtained is presumably tightly connected to the product development process and the end products that result from this.

Product development managers are “*intermediaries between consumer wishes, trends, production and product characteristics*” (Sijtsema et al., 2004, p.490).

However, although important for end product quality, there is limited knowledge about managerial quality goals and none on how these goals are linked to the product development competences perceived to support these goals. This relationship was explored in the Danish food industry in paper A, applying reversed laddering, a systematic method to uncover managerial quality goals and their hierarchical links to product development competences. The paper is included in the following.

2.2 Linking quality goals and product development competences (paper A)



Linking quality goals and product development competences

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Abstract

Quality is a main determinant of consumer food choice. Product development is accordingly a key activity for companies, because it generates the products on the quality of which consumer choices are based. In this respect, product development managers have a focal role, as their personal quality orientation influence the way product development is performed. The aim of this paper is to investigate managerial quality goals and how these may be linked to product development competences, which has not previously been studied. The study draws on an empirical, qualitative study in the Danish food industry, including reversed laddering sessions with 18 product development managers. Discrepancies between managerial and consumer quality goals are uncovered. Furthermore, the results point to two general dilemmas faced by product development managers in relation to quality; an external stakeholder dilemma of balancing the fulfilment of basic (legal) requirements and value-adding (consumer) demands, and a dilemma of internal priorities, balancing issues related to on-going production and to product development.

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Keywords: Quality; Managerial goals; Product development; Competences; Food industry; Reversed laddering

1. Introduction

The product development literature features extensive discussion about possible relationships between *how* products are developed (e.g. the product development process, organisation and competences) and *what* emerges from the development process (e.g. product diversity and end product characteristics). However, the underlying mechanism – *why* product development is performed in a certain way, resulting in a certain product output – has not been much discussed. In relation to food products, quality is a main determinant of product choice (Grunert, Baadsgaard, Larsen, & Madsen, 1996). Quality is tightly linked to product development, because the latter generates the products on which consumers base their choices. According to Hansen (2005, p. 90), meeting consumer needs in terms of food

product quality through product development is a highly complex endeavour: “*The producer must translate consumer criteria into producer criteria before the food products are designed, and must subsequently express producer criteria in consumer language.*” The way product development is performed in a specific company is furthermore influenced by what the individual product development manager believes to be good quality and how this should be achieved. Thus, product development managers’ own quality goals may shape product quality if they assign to the product development process specific competences perceived to support such quality. Links between individual quality goals and product development competences have not yet been the subject of scholarly attention. This relationship, however, does deserve scientific interest, because quality transcends all steps of the value chain, and is perceived in different ways by different actors, e.g. product development managers and consumers, and thereby also affects the actions taken to support quality goals.

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This paper aims to investigate managerial quality goals and their linkage to product development competences with a view to furthering our understanding of product development within the food industry. The research draws on empirical qualitative data involving product development managers in the Danish food industry. The food industry can be characterised as a consumer goods industry with quick product turn-over, immediate consumer product evaluation and a strong producer and consumer focus on quality (Avermaete et al., 2004; Grunert et al., 1997a). The industry is also described as generating a minimum of radical product innovations (Costa & Jongen, 2006). Meeting quality demands is therefore crucial, and the scope for differentiation is limited. The relevance of exploring the mechanisms affecting product development and end product quality from an industrial actor's point of view therefore lies in the potential long-term competitive advantage they may reap from such exploration.

The paper is structured in the following way: Section 2 discusses the theoretical background. In Section 3, the methodology and research design is presented. Section 4 presents and discusses the main results as well as managerial implications. Conclusions and directions for further research are featured in Section 5.

2. Theoretical background

This section will develop a theoretical framework for analysing links between quality goals and product development competences.

2.1. Quality

Quality is an interesting concept because it transcends all steps and all actors within the food chain, but it is of an intangible nature because it is perceived individually. It is widely accepted that product quality has both an objective and subjective dimension. As Issanchou (1996, p. 5) points out: “*food quality is not an inherent characteristic of the food*”, and it is further stated that the perception of food quality is shaped by both individual and contextual factors. Bremner (2000) suggests an approach to quality that links an over-all concept of quality, which in itself cannot be measured, to measurable quality parameters for specific products, measured by standard methods. Others have also suggested a quality measure combining parameters of an objective and measurable nature (Molnár, 1995). Garvin (1984) proposes a framework consisting of eight quality dimensions and argues that quality can be interpreted in many ways. As such, companies can pursue a quality-leading strategy in relation to their target consumers on different dimensions. Grunert et al. (1996) suggests a distinction between four different types of quality specifically related to food products, mirroring the general agreement in the literature that there is both a subjective and objective dimension of quality:

- *Product-oriented quality*, a food product's physical properties.
- *Process-oriented quality*, characteristics and principles of the production process, including the fulfilment of e.g. ethical production standards.
- *Quality control*, the extent to which product and process-oriented quality remains stable at a pre-specified level.
- *User-oriented quality*, a user's subjective quality perceptions.

As Grunert et al. (1996) points out, user-oriented quality, in particular, can also be influenced by quality factors of a more contextual nature, e.g. the purchase situation and price.

2.2. Product development competences

Competences are defined by Harmsen and Jensen (2004) as “...*internal skills, capabilities, processes, or actions...*”. There is little empirical literature on specific competences related to product development. Interest has centred on success factors of product development (Barclay, 1992; Brown & Eisenhardt, 1995) and conceptual discussions of product development as a competence in itself. Harmsen, Grunert, and Bove, (2000a), describe product development as being part of a network of interacting company competences. Eisenhardt and Martin (2000) describe product development as a dynamic capability – a process by which a company can integrate, reconfigure, gain and release resources. They do not mention the type of resources involved, although they emphasise that product development should be performed in cross-functional teams that bring together different sources of expertise. There is general agreement in the literature, however, that product development is becoming a more integrated process. This is also reflected in theoretical models of the process combining skills/knowledge related to products, processes and markets (Buijs, 2003; Cooper, 1994; Rothwell, 1992). Harmsen, Grunert, and Declerk (2000b) distinguish between three types of competences related to product development:

- *Product competences*;
- *Process competences*;
- *Market competences*.

The interplay between these competences, however, needs to be further researched, as suggested by Brown and Eisenhardt (1995).

2.3. Linking quality goals and competences

Theoretical assumptions and empirical constructs are illustrated in the research framework in Fig. 1.

A connection between orientation and competences has been discussed on a theoretical level by Harmsen et al.

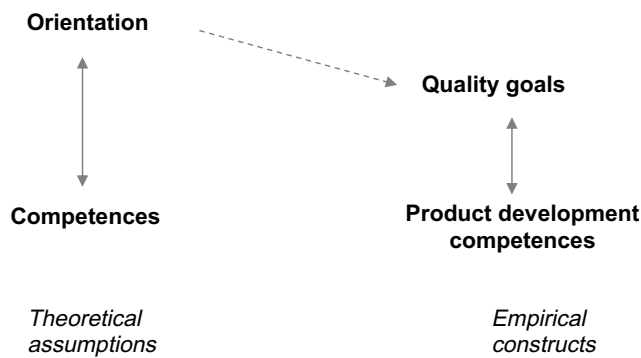


Fig. 1. Research framework of theoretical assumptions and empirical constructs.

(2000b, p. 157), who distinguish between orientation, competences and manifest behaviour (innovation): “...orientation is a mental construct which guides and evaluates behaviour, and thus is close to values and norms. Orientations therefore also guide the acquisition and perfection of skills and knowledge and thus the development of competences and capabilities. Manifest behaviour... will then be a result of the competences and capabilities built up and used in accordance with the prevalent orientations. This goes both for the individual and organisational level.” Company orientation is an abstract concept, which in itself is challenging to study. One approach to get closer to company orientation is to look at the individuals who together constitute the collective values and norms in the company, and who can be used as informants. When it comes to product development competences, the individuals responsible for this function are key informants and their personal orientation within this field must be assumed to be under substantial influence of their company’s strategic orientation. In the food industry, product quality plays a central role in product development. Product quality is the result of efforts which is put in to product development (and production) in a company – its product development competences. The product development manager guides the selection of which product development competences to apply in support of product quality, based on his or her personal orientation regarding quality (influenced by company orientation, educational background, experience, etc.). The personal quality orientation is not easily characterised through research however. Instead, we suggest to apply the operationalisation of quality orientation – *quality goals* – of the informant as a central construct in this study, and how these link in a top-down fashion to product development competences. Harmsen and Jensen (2004, p. 535) indicate the existence of such a link: “If we look at one goal at a time and this goal is to fulfil a certain market demand, the industry professional will want to apply certain competences that he believes will fulfil this demand. Such behaviour will be based on perceptions and beliefs that are formed by past experience and education”. We apply the typology of quality goals developed by Grunert et al. (1996) as well

as the typology of product development competences described by Harmsen et al. (2000b).

Harmsen et al. (2000b) argues that a company’s orientation will affect which competences are prioritised. As an example, market orientation will make market competences the primary focus (utilising company core competences), whereas product and process competences will become secondary competences. A more detailed example of orientation is that process-oriented companies focus their activities on developing and optimising processes in production units and whole food chains (Grunert et al., 1997a). According to Harmsen et al. (2000b), the orientation–competence relationship will also be mirrored at the managerial level (as quoted above). This indicates that a manager who primarily states product-oriented quality goals will stress product competences in product development and likewise goals focusing on process-oriented quality and quality control are expected to link to process competences, while user-oriented quality goals are expected to link to market competences. The relationship between organisational and managerial cognition at the empirical level remains, however, a controversial and unresolved research issue.

3. Empirical study

3.1. Design and method

The choice of methodology for the empirical study was guided by its purpose of uncovering individual’s quality goals and cognitive links to product development competences. This called for a qualitative and explorative method involving personal interaction with the informants. Questions should be open-ended, but to facilitate analysis of patterns in the links between quality goals and product development competences, some degree of systematisation was required. Thus, the study had both an exploratory aim as well as an aim to reach general propositions regarding the Danish food industry. The method ‘reversed laddering’ was chosen to reveal hierarchical links between managerial quality goals and product development competences in what may be called an end-means chain. This approach builds on the same principles as laddering, which is used for uncovering means–end chains, e.g. between concrete product attributes and a consumer’s personal life values or goals (Gutman, 1981). The use of laddering at the managerial level has also been demonstrated (Fiol & Huff, 1992). Inspired by cognitive psychology, reversed laddering draws on managerial cognition theory, which states that an individual is goal-oriented and tailors his/her situational behaviour to the desire of obtaining goals in accordance with personal perceptions and beliefs (Anderson, 1987). Laddering uncovers means–end chains (ladders) by using “why” questions, while reversed laddering applies “what” and “how” questions (Harmsen & Jensen, 2004). The hierarchical principle of both methods as well as the approach of analysis are similar, but where the laddering technique

employs a third construct between means and ends in the ladders, reversed laddering primarily works with two constructs, in this case quality goals (ends) and product development competences (means). Harmsen and Jensen (2004, p. 535) used reversed laddering to uncover key informants' "associations between perceived market demands and necessary company competences", defining competences as "...the internal skills, capabilities, processes, or actions mentioned by an informant when asked what it takes for a company to match a certain demand.". Furthermore, Harmsen et al. (2000a) applied reversed laddering to study links between perceptions of company success and competences.

3.2. Informants

Informants came from different food industry sectors (meat, dairy, vegetables, and packaging) and from companies of different sizes to avoid quality and competence bias, as these are factors generally recognized to play a role with regards to company performance and behaviour. Such key informant selection is in line with Harmsen and Jensen (2004) and served to obtain theoretical replication as described by Yin (1994), where all interviews fulfil a distinct purpose within the framework, based on their characteristics. The interviewees were all product development managers or similar because they have the responsibility for both setting relevant quality goals and for applying the appropriate competences needed to reach these goals in the product development process.

Key informants were identified in 24 companies, and letters sent out, describing the background for the survey, as well as practical details. In a follow-up phone call, a date for the interview (given that participation was accepted by the informant) was set. In the letter, the areas that the interview would focus on in relation to product development (and among these quality) were described, but no details about interview methodology were given at this point. Five of the smaller companies declined because of time constraints and one informant made a personal choice during the interview not to participate in the reversed laddering session. The 18 companies who participated in the reversed laddering were representative of the Danish food industry in terms of diversity and size. Key informants held positions of product development managers, sales vice presidents, sales managers, managing directors and quality managers and were all responsible for product development activities. The sessions were carried out in the course of six weeks in January and February 2005. Six out of 18 sessions were performed in person, the rest were performed by telephone.

3.3. Data collection

All sessions were performed in the same way by the same interviewer. The reversed laddering was performed after a semi-structured interview on product development of approximately 45 min, where the informants had a

chance to get comfortable with the interviewer in a minimally controlled interview setting. This was done to ensure an open and relaxed atmosphere, where the informants would feel confident to reveal and motivate personal views on quality. Prior to the agreed interview date, an illustration of the "tree structure" related to the quality section of the interview had been sent out to the informants to give them a sense of the systematic nature of the section of the interview dealing with quality (the reversed laddering session). The illustration merely showed a tree structure with the word "quality" placed as a starting point, branching out with several (blank) nodes. The separate nature of the two sections of the interview was stressed when briefing the informants beforehand and when switching from the interview to the reversed laddering session. Furthermore, the reversed laddering was described to the informants as an approach much more systematic than the semi-structured interview, pursuing to obtain an overview of the informant's quality perception.

Reversed laddering sessions were performed individually with key informants. Managerial quality goals were uncovered by asking "what is good quality to you", the interviewer noting every parameter and continuing probing until the informant had no further comments regarding quality. Each of the mentioned quality parameters and links to product development competences were then explored by asking "what does it take to ensure... [the specific parameter]" and probing by repeating the second question for each new element, until the informant could give no further explanations. Competences linked to each quality parameter were mapped during the session, using the previously described tree structure, resulting in visual representations of quality goals and the competences mentioned by the informant to be linked to them. Following the interview, the informants were sent a copy of their personal map for their own use.

3.4. Data analysis

The 18 resulting maps were used as a basis for the following analysis. An example of a map based on data from one single informant from the present study is presented in Fig. 2. The tree structure was divided into separate ladders for analytical purposes. Individual ladders were identified by starting at the individual elements at the bottom of the map and following the path, with one element at each level, until reaching the element "Quality". The map in Fig. 2 includes 11 ladders. As an example, the ladder on the left-hand side of the map consists of the elements microbiology – hygiene – product safety – quality.

Results were labelled so that they could be traced back to individual informants and then divided into groups of quality goals with similar characteristics. Quality goals were assigned to 25 groups and competences to 18 groups and furthermore coded according to the theoretically identified typologies of quality and product development competences.

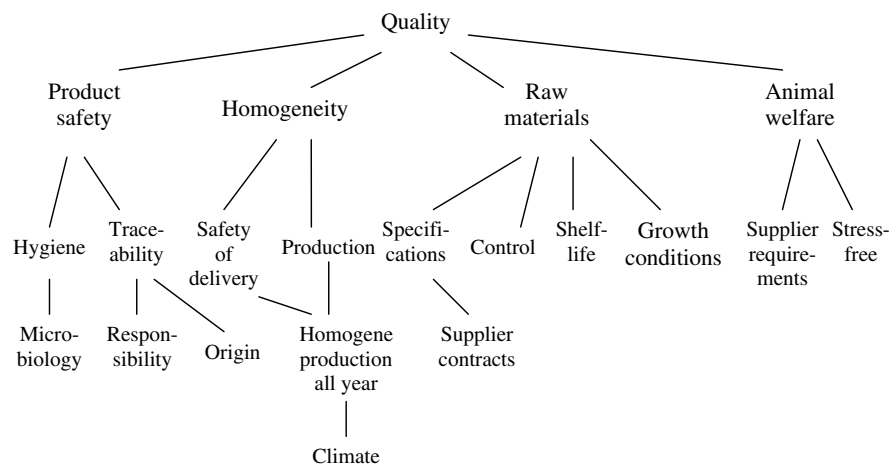


Fig. 2. Visual representation of reversed laddering session with one informant.

The software program MECAnalyst from Skymax-DG was used for the analysis (MECANALYST – Skymax-DG, 2006). Although the general purpose of the software is to serve as a tool for analysing links between different levels in cognitive maps of consumers, it is also applicable for analysis of reversed laddering data. MECAnalyst produces hierarchical maps on the basis of the data from each of the identified ladders. These maps create a general picture of the links between elements at different ladder levels, in this case between quality goals and product development competences. Elements that are not linked strongly enough (i.e. mentioned by a number of informants corresponding to

the chosen cut-off level), did not appear in the maps. Hierarchical maps were created for each of the four groups of quality goals according to the applied typology and a level of analysis was chosen giving a maximum of relevant information and transparency of maps. The map for all data related to process-oriented quality is given as an example in Fig. 3. The width of the arrows represent how strongly linked elements are to the level above. The level just below the box “process-oriented quality” represents the five quality goals which turned up in the data, the next two levels represent product development competences.

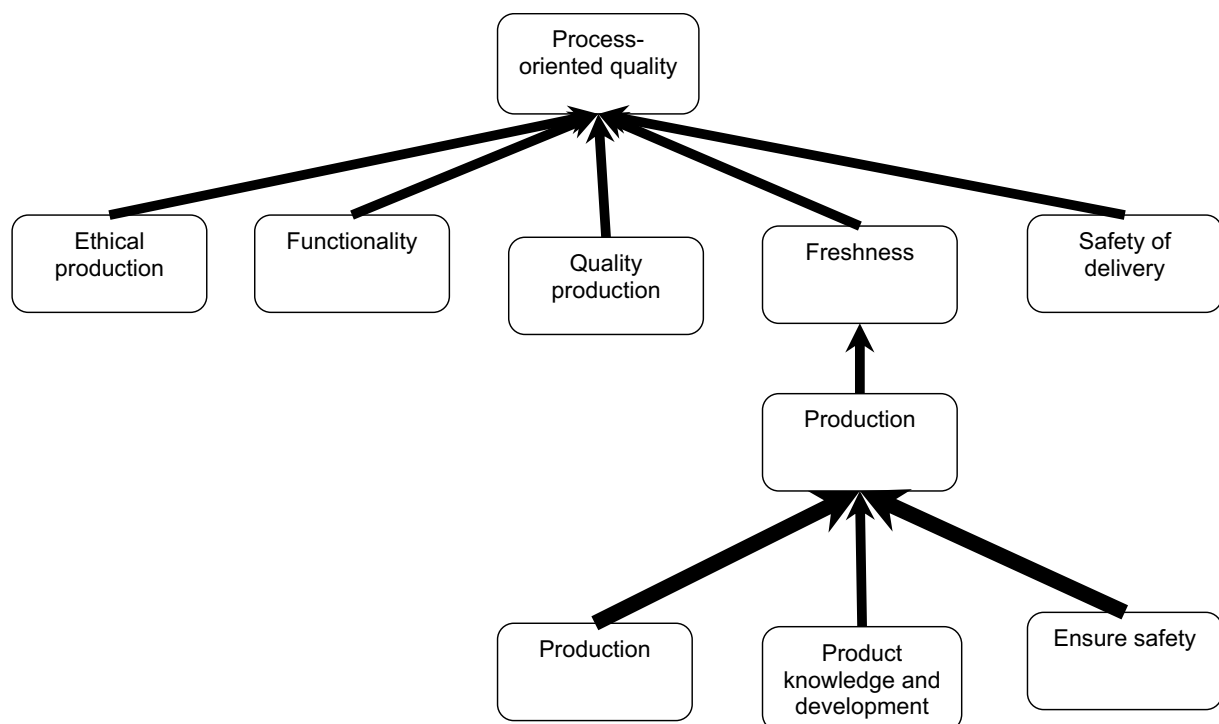


Fig. 3. Hierarchical map resulting from analysis of data related to process-oriented quality goals. The width of the arrows represent the strength of the links. At the second level from the top, quality goals are illustrated and the two lowest levels illustrate product development competences.

4. Results and discussion

4.1. Quality goals

Hierarchical maps were created for the four theoretically identified groups of quality goals, using a cut-off level of two. Fourteen of the 25 original sub-groups appeared in the maps, see [Table 1](#). The two most strongly represented quality goals were “food safety” (quality control) and “meet expectations” (user-oriented quality), which each was mentioned by a third of the informants.

The informants focused to a large extent on user-oriented quality. Meeting consumers’ and customers’ expectations was often mentioned, but also the sensory experience, and especially taste, was important. Sensory characteristics can, in principle, be categorised as both product and user-oriented quality characteristics, as they can also be quantified by professional tasting panels, but it was obvious from the reversed laddering sessions that informants were focusing on the personal, not the professional sensory experience. Quality control and process-oriented quality were also mentioned by many informants. Product-oriented quality was only included by about a quarter of the informants, but “raw materials” was the dominating factor mentioned (the only other thing mentioned in a few cases was the product itself).

The two most strongly represented types of quality goals, user-oriented quality, specifically “meet expectations”, and quality control, specifically “food safety”, point to a managerial dilemma in the food industry: how to balance the demands from authorities and consumers. Neither set of demands can be ignored. Although it can be argued that food safety should not be treated as a quality parameter in itself, but rather as a prerequisite for product and process parameters, food safety must be handled continuously to avoid serious consequences. It is therefore likely

to occupy a privileged position in the minds of product development managers. But food safety (and quality control in general) is no indication of the ability to sell products, while the ability to fulfil consumer and customer needs, indeed, is. The focus on quality control may limit the attention given to other quality dimensions, which are relevant in terms of consumer satisfaction and purchase.

Although the interviewed product development managers gave priority to user-oriented quality, the quality goals mentioned by the interviewed product development managers are not consistent with the four major food quality aspects mentioned by consumers, as described by [Brunso, Fjord, and Grunert, 2002](#). The authors conclude on the basis of numerous focus group studies that consumers emphasise four quality dimensions: health, taste, process characteristics (equivalent to “ethical production” in this study) and convenience. Convenience is not a part of the quality universe represented by the informants in the present study, although it is an issue which has been much discussed for more than a decade (see e.g. [Gofton, 1995](#); [Scholderer & Grunert, 2005](#)), and which also turned out to be very present in the minds of the informants in the interviews which were performed previous to the reversed laddering sessions. A possible explanation for this is that product development managers are relating quality solely to the product characteristics (viz. how it looks and tastes, if it is safe, etc.) and not to factors that influence whether consumers buy the product at all (convenience in terms of purchasing, preparation, consumption, disposition, etc.). Furthermore, the market for convenience products is acknowledged to be growing, but convenience is not thought of as a value-adding feature in itself. It is possible that informants think of convenience as playing an ambiguous role, involving ingredients or processing stages which could be perceived to compromise quality of the raw materials. Taste is one of the parameters on which informants focus, as are also, but to a lesser extent, health and process characteristics.

4.2. Product development competences

Seven of the 18 original product development competences were included in the hierarchical maps: three product competences, three process competences and one market competence ([Table 2](#)).

Table 1
Quality goals – results, $n = 18$

Quality parameter	No. of informants	Sub-elements	No. of informants
Product-oriented quality	5	Raw materials	4
Process-oriented quality	9	Freshness	2
		Safety of delivery	2
		Quality production	2
		Ethical production	2
		Functionality	2
User-oriented quality	14	Meet expectations	6
		Sensory experience	4
		Taste	4
		Health	2
		Credibility	2
Quality control	11	Food safety	6
		Homogeneity	5
		Comply with specifications	3

Table 2
Product development competences – results

Product development competence	Sub-elements
Product competences	Comply with specifications Product knowledge and development Selection of raw materials
Process competences	Production Control systems Ensure safety
Market competences	Communication

The product competences included traditional activities of product development departments, especially “product knowledge and development”. Process competences focused on production, including control and safety dimensions. The only market competence included in the map was “communication”.

It is only natural that product development managers include in their priorities the product competence “product knowledge and development”, which must be presumed to be their main area of responsibility. The product competence “selection of raw materials” is also relevant, as it affects product development outcomes and possibilities. Furthermore, the market competence “communication” plays a central role. “Comply with specifications” is linked to product development because specifications are often translations of consumer demands. This competence, however, is also related to the on-going production where products have left the development phase, and are in principle no longer the responsibility of the product development department. Informants mentioned specifications as a means of e.g. ensuring food safety and raw materials, which indicates a relation more to control than to development. It is interesting that these dimensions of complying with specifications, as well as the process competences “control systems”, “production”, and “ensure safety” are underlined by managers responsible for product development. It is important to ensure that products are safe and producible. However, these issues are often regarded by consumers as basic characteristics of the food and not as value-adding activities. It is therefore possible, as was the case with quality, that there is a need for shifting the focus in relation to application of product development competences.

Another interesting aspect was the competences that were *not* included in the maps. What could have been expected to be linked, especially to user-oriented quality, was a market competence such as knowledge, including the systematic gathering of market information. The only market competence linked to any of the quality goals was communication, which included factors such as information dissemination and dialogue with customers and consumers. However, application of the information obtained by such interaction requires a system for collection and activation of that knowledge. Thus, market competences do not seem to be employed in an interplay with the product development managers, if at all, in the companies in question. Several authors have also pointed to the need for integration between product development, marketing and production (see e.g. Rothwell (1994)). The focus on process and product competences as described above could therefore be supplemented by a more pronounced application of market competences. Such integration needs to be based on strong core competences within each area, e.g. placed in separate departments. Thus, it is companies and not individual managers who should engage in integration of different functions to facilitate optimisation of product development efforts.

The above results seem to imply that the interviewed product development managers focus on many issues related to the on-going production issues. Apart from individual contextual factors such as educational background, culture and experience, it seems that also company orientation has a marked influence on managerial quality goals, given the consistency of results across the sample and with previous findings of the food industry being primarily process- and/or product-oriented (Grunert, Harmsen, Meulenberg, & Traill, 1997b). This focus on process competences rests on at least four characteristics of the food industry. Firstly, many Danish food companies have a cooperative tradition that rests on a principle of equal treatment of its members (suppliers). Focus is accordingly on large quantities and standard quality products, which in turn promotes a focus on process optimisation (Søgaard, 1994). Secondly, although many food companies primarily offer consumer goods, they trade through an intermediary – a retailer or an industry customer – and have no direct contact with the consumer. They are therefore compelled to focus on prices and effectiveness in product development and production, while having a more user-oriented approach to product quality in general. A third factor which can explain the focus on process competences is the human relations strategy of many food producing companies, where product development managers are often responsible for both quality control (i.e. food safety) and product development. They may have a technical education or be food professionals (baker, butcher, etc.). This was recently confirmed in a regional Danish survey (CUTA, 2005). Finally, food products are subject to legislation related to, e.g. food safety, which places a day-to-day pressure on managers to give first priority to this aspect.

4.3. Linking goals and competences

Fig. 4 gives an overview of the identified primary links between quality goals and product development competences.

A single relationship was found between product-oriented quality and product competences as was a relationship between process-oriented quality and process competences. The quality control goal “food safety” linked to five different competences, both process, product and market competences, while “homogeneity” only linked to one process competence. Only one of the user-oriented quality sub-groups (namely “meet expectations”) linked to market competences, but also to the product competence “comply with specifications”. “Taste” linked to a product and a process competence and “health” linked to the product competence “selection of raw materials”.

As described in Section 2.3, it was assumed, based on theory, that the type of managerial quality goals would also guide competence selection related to that orientation. This turned out to be the case for the product- and process-oriented goals and competences. As mentioned earlier, this is also where food companies typically focus their efforts,

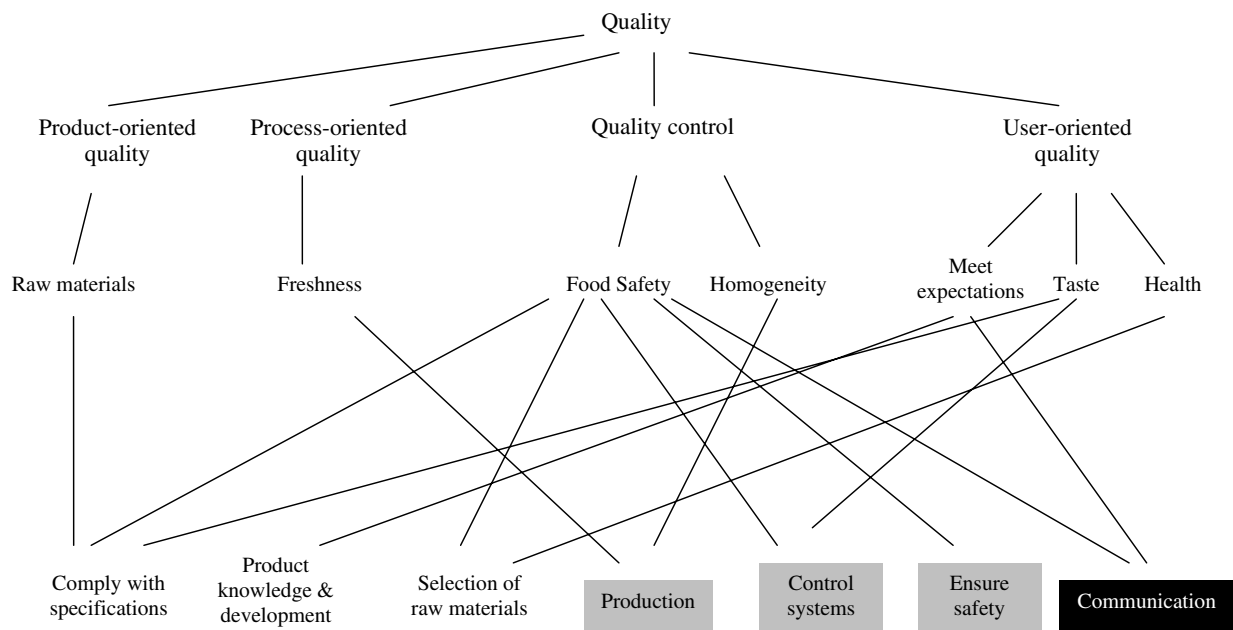


Fig. 4. Overview of results from the study regarding links between quality goals and product development competencies. Color code for product development competencies (bottom layer): no colouring – product competences, grey – process competences, black – market competences.

and this might therefore have a more consistent influence on product development managers. For goals related to quality control and user-oriented quality, results were more blurred. While the goals “homogeneity”, “health” and “meeting expectations” were linked to product development competences, which were explainable according to the framework, other links were more unexpected. “Food safety”, one of the most dominant quality parameters, had the most complex pattern of links to five different competence sub-elements. This is interesting because food safety is not necessarily a direct product development concern (as discussed in Section 4.1) and because it has links to many different competences. The link to the market competence “communication” is particularly interesting, because it indicates that managers perceive food safety to be an important factor to communicate and promote in relation to products, although it should, in principle, be more about control than communication.

Another interesting link is found between the user-oriented quality parameter “taste” and the competences “comply with specifications” and “control systems”. “Taste” is not linked to other competences, although it would have been natural that “taste” had been linked to “product knowledge and development” or “selection of raw materials”. This could be an indication that taste is primarily perceived as something which is controlled at a specified level and that the specification in itself is not an important product development issue. Furthermore, as mentioned in Section 4.2, a large part of the Danish food industry are tightly integrated in the vertical value chain because of the cooperative structure, which means that raw materials in many cases are a matter of availability and not selection.

The uncovered indications of a primarily process and/or product-oriented (and not market-oriented) industry may be a specific characteristic of food companies, which would be consistent with earlier findings (Grunert et al., 1997b). The dilemmas identified in this study of balancing authority and consumer demands as well as production and product development issues furthermore support this interpretation and can to some degree explain the low degree of radical product innovation in the food industry.

4.4. Managerial implications

Product development managers play an important role in defining and achieving product quality in food production. Managers may therefore benefit from a higher level of consciousness about *why* they develop product the way they do, *how* they perform product development, and *what* results from the process.

The focus on competences such as “control systems”, “ensure safety” and “comply with specifications” of product development managers in the Danish Food Industry is not surprising in itself, as it is a daily challenge to meet demands and goal set by both internal and external parties. As discussed in this paper, however, this focus does not necessarily add any value to products in the consumers’ view or lead to larger market shares. Fulfilment of requirements from authorities and demands of product and product consistency should, of course, not be neglected, but it should be considered whether it is an issue that can be handled by other, more control-oriented functions in food companies than product development departments. This would allow product development managers to devote their attention more to value-adding activities. In the

Danish food industry where 90% of the companies have less than 50 employees (Confederation of Danish Industries, 2006), this is not always possible – or desirable. Product development managers in these companies will typically have several areas of responsibility, combining, e.g. quality control with product development. In many cases, the literature encourages the integration of product development and production, but control issues do not support development directly, and it should be considered whether such issues could be applied more directly to production as an independent function.

The focus on user-oriented quality is a good indication of the interest in fulfilling consumer needs, but a stronger focus on the end-users and their actual needs will assist managers in formulating clear and relevant quality goals and allow them to better act upon them. A first step could be to include the four major dimensions of quality for consumers, health, taste, process characteristics and convenience, as discussed in Section 4.1. Results also indicate that a higher degree of internal integration of product development in the companies, e.g. with the marketing function, is recommendable to create a more balanced approach to quality and product development.

5. Conclusions

This paper set out to investigate managerial quality goals and their links to product development competences with a view furthering our understanding of product development in the food industry.

The results from the study indicate an inconsistency between managerial quality goals and the major quality factors for consumers found in the literature. As an example, the dominant market trend convenience was not included as a quality dimension by any of the interviewed managers. Only taste was both important for managers and consumers, but the managers' main focus remained to be food safety and compliance with specifications. With regards to quality as well as product development competences, the interviewed product development managers had a product and process focus. This is in line with previous findings of food companies being more product and process than market-oriented, and implies some degree of alignment between managerial orientation and the strategic orientation of their companies.

The results point to two general dilemmas faced by product development managers in the Danish food industry: an external stakeholder dilemma of balancing the fulfilment of basic (legal) requirements and value-adding demands, and a dilemma of internal priorities of how to balance issues related to on-going production and product development in itself. These dilemmas reflect some characteristics of the Danish food industry: its roots in the cooperative tradition, the role of intermediaries, the human relations strategy and legislation. The dilemmas identified in this study can to some degree explain the sub-optimal conditions for innovation characterising the food industry.

5.1. Further research

This study explores a new field within a relatively limited sample. Building on the results, we suggest three future research areas: (1) a further validation of the present findings (2) analysing the appropriateness of managerial quality goals (and consequently the related product development competences) in relation to consumer quality goals and (3) analysing factors affecting the formation of managerial quality goals. These will be described below.

The dilemmas described in this study of legal requirements vs. consumer demands as well as production vs. product development deserve further scholarly attention. Further research should aim at further validating and developing the present findings, both in the food industry and in other industries.

The present paper focus on managerial quality goals and the linkages to product development competences. A natural further step is to investigate the forward link to product quality and consumer attitudes in order to uncover information on the appropriateness of managerial quality goals, and consequently the applied product development competences in relation to consumer quality goals. The comparison of managerial quality goals with the four major food quality aspects for consumers indicated discrepancies, e.g. related to convenience and could in this respect be an interesting framework for further research.

Another interesting aspect would be which factors influence managerial quality goals, both individually and in the organisation they are a part of. This would shed further light on the formation and implications of managerial quality goals as well as the assignment and application of product development competences. This could include an in-depth analysis of managers in the context of e.g. their background, company communication mechanisms and procedures and consciousness about what affects end product quality.

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2.3 The quality cycle

Paper A presents the thoughts brought forward by Harmsen et al. (2000), who argue that orientation guides the development of competences and results in manifest behaviour. These thoughts have been further developed in the context of quality and product development within the frame of the present research. This has resulted in the conceptual framework, the “quality cycle”, see Figure 2.1. The quality cycle includes the crucial factors influencing the match between what consumers demand and what producers offer. The quality cycle is based on a movement from managerial quality goals (which optimally should be aligned with consumer quality perceptions), which influence the choice of product development competences applied in the process, which, in turn, generate the products on which consumer quality perceptions are based. The quality cycle will be used and developed throughout this dissertation and the hypothesised mediating effects of product development alliances and modularisation will also be placed within this frame.

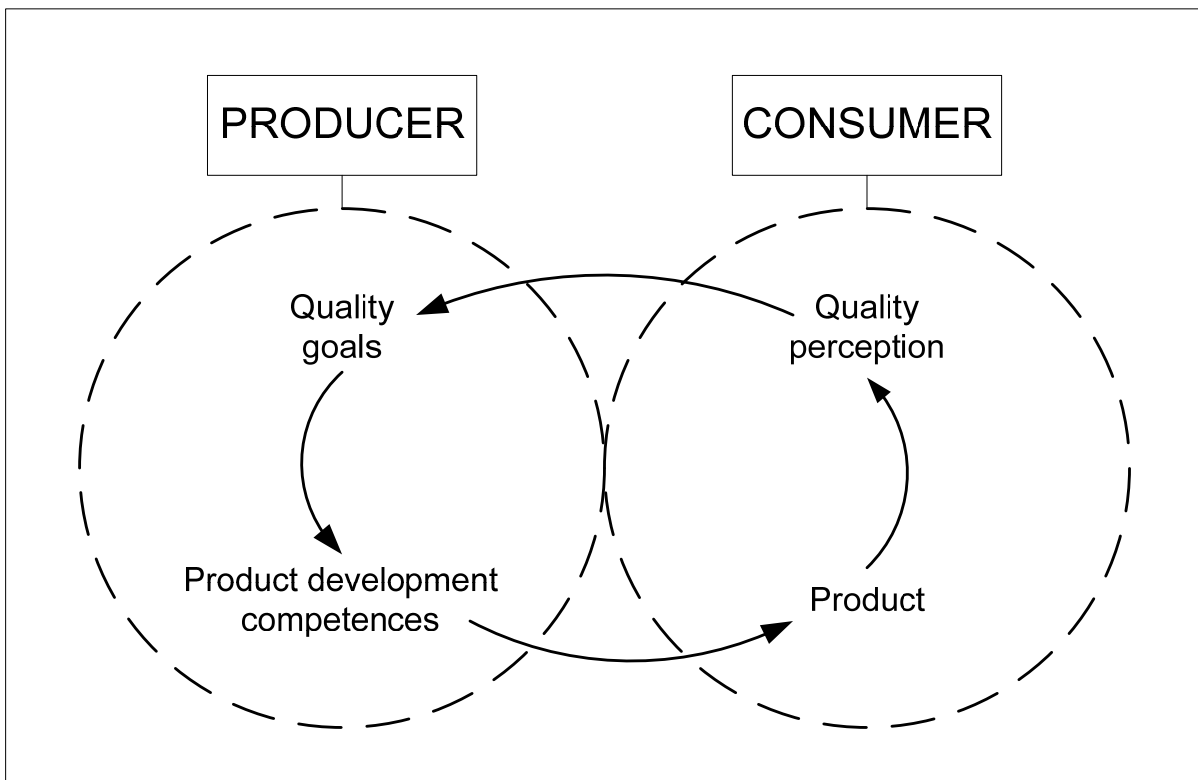


Figure 2.1 – the quality cycle, a conceptual framework illustrating the links between quality perceptions, quality goals, product development and end product.

2.4 Meal solutions – market and quality

To supplement the discussion of product development in the food industry given in paper A, the following will focus more on the market for meal solutions, motivating the choice of this setting in the dissertation, and it will discuss quality parameters within this context.

2.4.1 Market development

Within a relatively short period of time, the food industry has shifted its focus from production of traditional consumer products such as meat, cereals, milk, etc., to the production of more processed foods that are increasingly convenient in terms of e.g. purchase, preparation, meal composition and disposal. At the same time, technological possibilities and traditions have changed the way that food products are being consumed. Changes have, for example, been seen within the catering sector, which every day serves consumers in hospitals, canteens, restaurants, etc. Meal production used to be "just-in-time", but now we see a change in the structure of the catering sector, where components of the meal are produced to stock and only assembly and serving takes place close to the end consumer. An increasing share of production is carried out centrally in larger units, or delivered from food-producing companies (Mikkelsen et al, 2004; Engelund et al, 2007). In the USA, the food service sector (meals consumed away from home) was responsible for 49% of all food expenditure in 2007 (USDA, 2008), and in Europe the figure has earlier been estimated to be 35-40% and rising (IFAU, 2003); in Denmark the percentage was 33% in 2007 (Danish Agricultural Council, 2008a). The need for fast solutions and convenience products is growing as the demographics are changing towards more single-households, elderly people and families with two working parents. These developments contribute to the general trend of time scarcity among consumers (Costa et al, 2001; Jabs & Devine, 2006). To this should be added a lack of competencies in food handling, primarily among young people (Otlersdorf, 2003). Scholderer & Grunert (2005) underline that the driving forces are the subjective rather than objective time pressure combined with a general development of a more positive attitude towards convenience. Meal solutions are undoubtedly becoming more and more central in the minds and actions of the consumer.

2.4.2 Central quality characteristics

As consumers are exposed more to meal solutions, also in situations where they have more freedom of choice, they are becoming increasingly demanding, wanting complex and high-quality products as well as a higher degree of variation in product offerings (Euro-monitor, 2006; van der Valk & Wynstra, 2005). As an example of the latter, Candel (2001) found non-convenience oriented⁸ consumers (who, as the market for meal solutions expands, also must be expected to be exposed to meal solutions more often) to emphasise variation between and within meals more than convenience-oriented consumers. Furthermore, quality expectations are often based on home-made meals, of which consumers also generally think more positively than meal solutions⁹ (Cardello et al, 1996; Costa et al 2007; Prim et al., 2007).

As mentioned previously, it is important in relation to specific product development activities, to be conscious about which quality characteristics are important for the chosen consumer segment(s) and product group(s) as well as in the consumption situation (Ahlgren et al. 2005). This is in line with the recommendations made by Bremner (2000). Consumer demands in relation to meal solutions also have to be updated for specific product development activities. For meal solutions, some challenges exist in relation to the consumers' general perception of the quality of these products. Prim et al. (2007) discussed ready meals with Swedish consumers in five focus groups and found that they are generally consumed at lunch-time, were generally considered unhealthy and not as appropriate for dinner as e.g. take-away meals or combining prepared meal components. Costa et al. (2007) furthermore found that the replacement of home-made meals with ready-meals is based on a trade-off between the perceived health and taste benefits and convenience features. Convenience is an important feature (Candel, 2001), which, in itself, is complex. Darian & Cohen (1995) suggest two broad defining dimensions of a) what type of resource is saved (time, physical or mental energy) and b) in what stage of the consumption process (planning, purchasing, preparation, eating, cleaning up).

⁸ Convenience orientation is defined as “*the degree to which a consumer is inclined to save time and energy as regards meal preparation*” (Candel, 2001)

⁹ In this dissertation understood as a main course or pre-assembled main course components bought outside the home. This is in line with Costa et al. (2001) who state that meal solutions include all products available as replacements for consumers, who cannot or will not fully cook a main meal at home.

It is also a challenge for producers to differentiate their product offerings on supplementary and perhaps more value-adding quality characteristics. This operationalisation of quality requires specific knowledge. In focus groups discussing ready-meals (Prim et al., 2007), it was concluded that more vegetables should be included and that their preparation should be optimised to ensure a crispy texture. Ready-meals should have more varied and interesting flavours, have a healthier profile and, furthermore, the consumers wanted to be more involved in meal composition and / or preparation. Benner et al. (2003a) conclude that four important quality characteristics in relation to ready-meals are convenience, healthiness, sensory characteristics and safety. Reisfelt et al (in press) investigated consumer preferences for visually presented meals and for a specific combination of 5 different meal components at two levels they found that consumers generally preferred modern types of dish (as opposed to traditional) with meat in smaller pieces and without herbs, but that demographic factors such as gender and age significantly influenced the choice of dish. Data related to other products (also other types of meal solutions than ready-meals), consumers, situations, etc., must be assumed to generate unique knowledge in each setting; a knowledge that can be applied in the product development process to optimise quality.

2.4.3 Matching consumer demands

It is definitely a challenge – but also a promising opportunity – for actors in the food industry to respond to consumer demands in the market for meal solutions. In the questionnaire, 40 informants prioritised convenience along with health and quality as the most important food trends for future product development. Twenty-seven product development managers answered questions specifically related to meal solutions and the expected development in this area. All informants agreed that meal solutions will increase their market share in the future and that consumers will focus on quality, variation and/or customization, health, convenience and, to some degree, freshness. Results point to retail and convenience shops and to a lesser degree schools and canteens as important sales channels for meal solutions.

In 2007, Monday Morning¹⁰ set the frame for development of concepts for the healthy supermarket of the future, in a workshop with 55 participants from the Danish retail and food industries, health and industry associations, research institutions and authorities (Huset Mandag Morgen, 2007). It was agreed that one of the barriers for healthy eating was that consumers knew too little about how to compose and prepare healthy meals. Suggested solutions to this were improved availability of new types of partially prepared meal components, co-packed meal ingredients, redesigning supermarket areas around meals as well as in-store computer systems for meal composition. Initiatives in the Danish food industry also support these thoughts, e.g. with home delivered ready-to-prepare meal solutions from retnemt.dk, Aarstiderne and Skagenfood. In Sweden, a new “meal idea” has been presented by Operakällaren, a well-known restaurant, and Lantmännen, Sweden’s largest raw materials supplier (Gooh!, 2008). The idea is to offer all consumers good and healthy ready-to-eat meal solutions at a reasonable price and from different types of outlets. Thus, the concept aims at fulfilling many and varying consumer demands

As described in this section, meal solutions represent an interesting market opportunity for food producers, and quality as well as customisation / variation seem to be important competition parameters. However, compared with “traditional”, more simple, products, the industry is facing a number of challenges related to the general negative attitude towards the quality of meal solutions among consumers as well as their increasingly complex quality demands. Product development in the context of meal solutions, furthermore, involves new factors, which will be discussed in the following.

2.5 Challenges of meal solution development

If, within the context of meal solutions, return to the quality cycle presented above, the relationship between the factors looks more complicated, see Figure 2.2.

¹⁰ Scandinavias biggest independent think tank (Mandag Morgen, 2008)

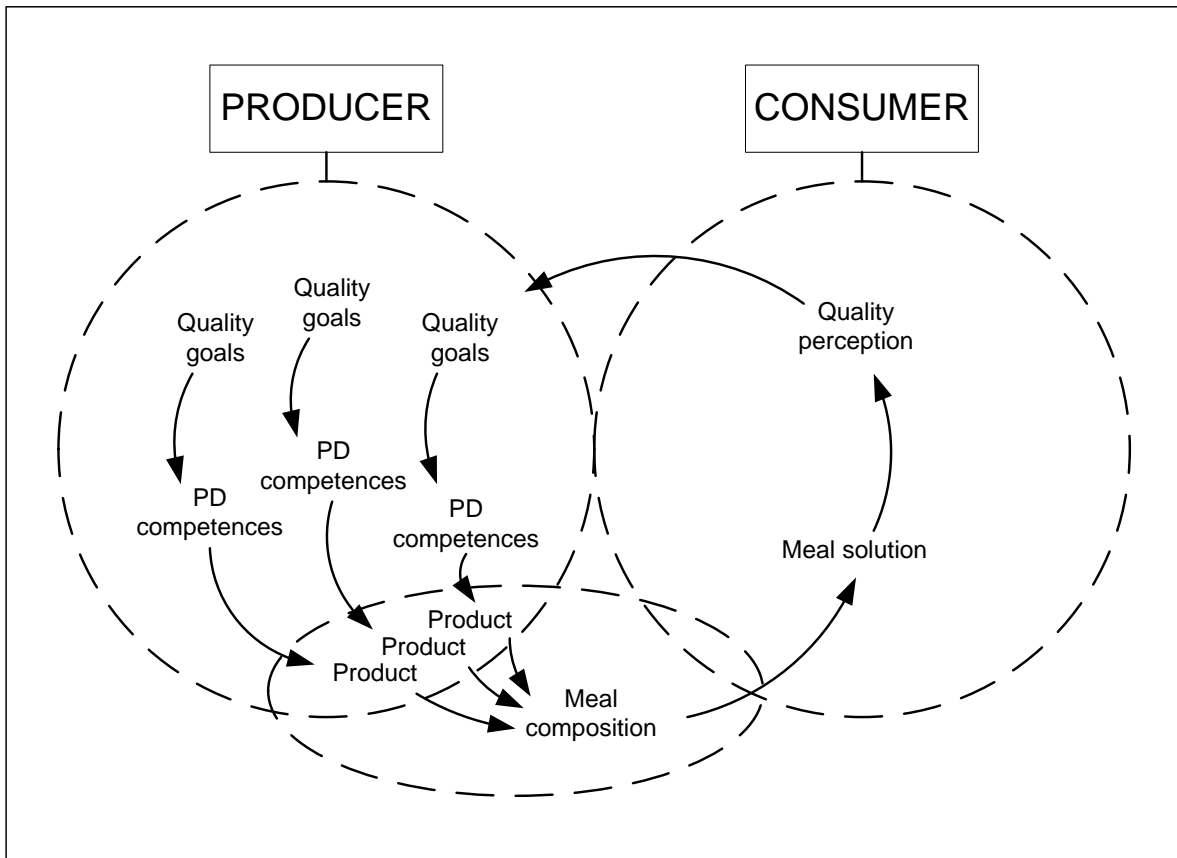


Figure 2.2. The quality cycle adapted to the context of meal solutions. PD: product development

Consumers do not simply base their quality perception on a single product from one producer. Several products are usually combined and processed to form the final meal solution. More producers are accordingly involved in the development and production of the final meal. This enhances the risk that a given end product does not fulfil quality demands because its constituting components are subject to the influence from numerous company systems. If producers are developing and producing meal components with different quality goals in mind, the risk is high that the consumer will experience an end product whose quality is incoherent and unsatisfactory. Furthermore, a new element in the quality cycle is introduced where meal components are being combined. This step is crucial for the potential consumer quality perception of both components and meal solution. Responsibility for the end product *can* lie with the producer or the consumer, but it is often placed with a third party, e.g. a large-scale kitchen or a ready-meal producer. This intermediary step can in the worst case cause a negative consumer quality perception of the meal solution and in

the best case act as a facilitator of the meal solution meeting consumer demands, and has to be taken into consideration.

Exploiting the potential of inter-organisational cooperation between producers of the different meal components represents one possible way of enhancing involvement in meal composition (and thus how single components are presented) and of reducing the complexity of improving quality. In so-called product development alliances, the parties involved can potentially use the composition step proactively, ensuring relevance of the quality goals set for meal solution and components as well as the competences employed in product development. This is further described in chapter 3.

2.6 Conclusions and implications

This chapter has presented several important aspects of food quality perception as well as related product development challenges.

Quality is a crucial factor shaping the producer's product development and the consumer's choice. Quality optimisation is complex for three main reasons: 1) it is subject to individual perceptions and preferences, 2) there is a risk a mismatch between producer's and consumer's quality priorities, and 3) appropriate competences are not always employed in the product development process in terms of supporting quality goals. This creates difficulties in matching consumer demands with producer supply - what consumers perceive to be good quality ultimately has to be tightly connected to, and aligned with, quality goals of key actors in the producing company, as well as with the main competences employed in the product development process. This is illustrated in the conceptual framework of the quality cycle, which is further developed to illustrate the added challenges for producers of developing and delivering complex products – meal solutions – of a relevant quality.

For product development managers in the food industry, it is crucial, if quality optimisation is a goal, to support the product development process by building and applying knowledge on consumer demands in relation to e.g. specific end products, consumption situations, segments, sales channels, etc. As described, meal solutions represent an important and developing market. Product development efforts in this area should be prioritised and fo-

cus on quality optimisation. Furthermore, managers should be aware whether managerial goals and consumer quality demands are aligned as well as ensure that these quality goals are actually met through the competences applied in the product development and production process.

Further research needs have been introduced in paper A, but one area should be highlighted here: The applicability of the quality cycle could be strengthened by research into the relationship between consumer quality perceptions and managerial quality goals, preferably in the context of meal solutions. Such research would fill a gap in extant literature.

3 MEAL DEVELOPMENT ALLIANCES

This chapter will explore the concept of product development alliances, how they are formed and succeed and how they can contribute to meal solution development and quality optimisation. Paper B explores motivations for food producers to enter into product development alliances and how these alliances can succeed. Then, a typology for product development alliances in the food industry is introduced together with the concept for meal development alliances. The mediating role of meal development alliances in the quality cycle will be discussed, as will the inherent complexity of this form of cooperation. The main research questions posed in this chapter is:

RQB: Can product development alliances facilitate quality improvements of meal solutions and how can they be initiated and succeed?

3.1 Motivations for entering product development alliances

Product development alliances¹¹ are common in high-tech industries producing e.g. software, cars, and telecommunications. Products are so complex that producers cannot include all relevant competencies for development and production in-house if they want to maintain a focus on high quality and cost efficient products (Hagedoorn, 1993). The development towards focusing on core competencies (Prahalad & Hamel, 1990) makes cooperation on many levels crucial to keep both in-house and outsourced activities at a satisfactory level and well-coordinated. Furthermore, globalization is changing the rules of competition on Western markets and producers can no longer rely on mass production at high prices (Drejer, 2004).

Products need to have a high built-in level of knowledge, to be able to withstand the competition and differentiate themselves from cheaper products just fulfilling minimum quality requirements, such as inter-product homogeneity and food safety. Inter-organisational product development can support this kind of knowledge-intensive products. As stated by Harrison et al. (2001, p. 680): *"Basically, the need to be globally competitive requires or-*

¹¹ "Interorganisational arrangements in which the partnering firms combine personnel for the joint design of a new product and where at least one of the partners will sell the product" (Eisenhardt & Schoonhoven, 1996, p. 42), also in line with Millson & Raj (1996.), which defines them as being "any form of formal or informal cooperative arrangement related to the joint development and commercialisation of new products".

ganizations to combine or co-operate". Sheth & Parvatiyar (1995) furthermore finds that competitive advantage can be supported by strengthening relationships to customers, suppliers and other actors through involvement and integration in marketing and developmental activities.

The concept of resource complementarity (Harrison et al., 2001) is relevant to apply to a context of inter-firm product development, where relationships may be horizontal, e.g. between producers of different components of a meal. Companies can potentially strengthen the development of components and the final product by entering into product development together, but still sell components separately to the next actor in the production chain (another company, a wholesaler, a retailer, etc.). Grant & Baden-Fuller (2004, p. 69) underline the potential of forming a relationship, proposing that *"...where products require a broad range of different knowledge types, efficiency of integration is maximized through separate firms specializing in different areas of knowledge and linked by strategic alliances"*. This is supported by Harrison et al. (2001), who stress the importance of resource complementarity rather than similarity for successful inter-firm relationships. Furthermore, Sengupta (1998) focuses on resources related to specific products, urging companies to analyse strategic opportunities of product development of value-adding products, which complement the company's existing products. Hagedoorn (1993) poses the research question of "why companies cooperate in their effort to innovate" and searches for answers by analysing motives for entering into partnerships in different sectors. The author concludes that the three major incentives for partnership formation are technology complementarity, reduction of innovation time-span and market access / influencing market structure. Furthermore, he concludes that mature industries and low-tech industries, such as the food and beverage industry, are primarily focused on the latter motivation factor. Pszczola (2004) supports this view.

3.2 Potential of developing meal solutions in alliances

Although not much industry-specific literature exists, general theory and the characteristics of the industry suggest that forming product development alliances would be a reasonable strategic choice for food companies. The market development towards a growing demand for high quality and varied meal solutions certainly implies that end products require inte-

gration of several different types of knowledge and products; doing so within the context of an alliance is, indeed, relevant (Grant & Baden-Fuller, 2004). Apart from the benefits product development alliances related to this market development can offer to consumers, they also present food producers with an opportunity to protect core competences, e.g. related to large-scale production processes, and to raise the barriers to entry to the market (Johansson & Elg, 2002). Furthermore, meal development alliances in the food industry should have some implicit benefits compared with other industries, as creativity is supported through low initial development costs and easy access to prototypes, which can be produced in small scale and at a low cost of raw materials and working hours (Kristensen 1992).

The more complex the products demanded (in relation to a company's ability to fulfil that demand alone), the more likely it seems that companies develop relationships with other parties. Research on these types of activities in the food industry (and in low technology industries in general), however, is sparse, and the literature on inter-firm product development is, furthermore, focused on vertical relationships (supplier-customer). To shed some light on the reasons for this presumably low degree of inter-organisational product development activities, it is of interest to uncover factors of importance to the formation and success of product development alliances. Paper B presents research on this topic in the context of the Danish food industry. The paper contributes to the scarce literature in this area, inter-organisational product development in the food industry has so far only addressed supplier involvement in the development of rather simple products (van der Walk & Wynstra, 2005; Pszczola, 2004).

3.3 Factors influencing formation and success (paper B)



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Product development alliances: factors influencing formation and success

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Abstract

Purpose – The objective of this paper is to develop a framework, based on existing literature, for factors influencing the formation and success of product development alliances, and relate this specifically to the food industry.

Design/methodology/approach – Case study of a product development alliance, with four partners and an interview survey, with 19 key informants in the Danish food industry.

Findings – The nature of the differences between the developed framework for product development alliances in the food industry and theory on alliances in general, indeed seem to rest in the chosen specific context. Companies in the food industry are not forced by external conditions to enter into product development alliances. Therefore, compared to other industries, motivations have to be stronger or risks smaller for them to form such interorganisational relationships. However, once formed, results indicate that success factors are rather universal across industries and types of alliances.

Research limitations/implications – Further research should explore the findings further, both within the food industry context, as well as more broadly in terms of geography and industry.

Practical implications – Managers obtain a tool for planning and refining their innovation strategy and actions regarding product development alliances.

Originality/value – This research contributes to the presently limited literature on product development alliances, specifically in the food industry context.

Keywords Product development, Strategic alliances, Qualitative research, Food industry

Paper type Research paper



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Introduction

Consumers are demanding more complex and high-quality food products as well as more variation in product offerings (Euromonitor International, 2006; Van der Valk and Wynstra, 2005). This places new demands on food producers, who typically, however, do not possess all necessary competences to develop and produce a complex product (such as a ready-made meal) within the individual company. Therefore, if they wish to meet the new demands, they have a choice of either building all necessary competences in-house or enter into collaborative relationships with partners with complementary competences on product development. Earlier findings suggest that inter-firm alliances presents a promising way of combining resources, if a broad range of different competences and knowledge are related to product (Grant and

Baden-Fuller, 2004), as is often the case in the food industry. Thus, there seems to be a potential for food companies to enter into product development alliances.

The literature has a broad scope on alliances as such, furthermore focusing on high-tech industries, leaving the impression of sparse research in product development alliances, and even less within the food industry. Although this indicates few formalised product development alliances in the food industry, potential benefits of such endeavours also exist. It is therefore interesting to investigate what constitutes a successful alliance in this context as well as which factors influence their formation in the first place. The objective of this paper is to develop a framework, based on existing literature, for factors influencing the formation and success of product development alliances, and relate this specifically to the food industry.

A literature-based framework for product development alliances

Product development alliances are interorganisational arrangements in which the partnering firms combine personnel for the joint design of a new product and where at least one of the partners will sell the product. This definition follows Eisenhardt and Schoonhoven (1996, p. 142). This definition was chosen based on the lack of literature on such activities specifically relating to the food industry, underlining the need for an open approach. An example of such an alliance could be joint development of a ready-made meal in collaboration between producers of different components, e.g. meat, vegetables, spices and packaging. Product development alliances can be considered as a relationship marketing activity, supporting a company's competitive advantage by strengthening the relationship with its customers, suppliers and other actors through involvement in marketing and developmental activities (Sheth and Parvatiyar, 1995).

The literature related to product development alliances is not comprehensive, nor well defined. Furthermore, research in this field in the specific context of the food industry is very sparse. Relevant knowledge has to be extracted from the more general literature covering issues such as strategic alliances, co-development and product development. The majority of this literature can be placed within a product development management paradigm in relation to alliances, but do also include aspects of, e.g. transaction cost economics (emphasising economic motives for forming alliances) and a resource based view of alliances (emphasising strategy and competences as the drivers). Thus, the literature search has been performed within a broad frame of reference based on the applied definition of product development alliances, using key word searches and "snowballing" based on references from previously identified literature. Furthermore, relevant sources referring specifically to the food industry were also identified.

Many types of different interorganisational constellations fit into the general frame of product development alliances. Research in this field has primarily focused on vertical co-operation between suppliers and customers (e.g. Campell and Cooper, 1999; Cante *et al.*, 2004). Horizontal alliances (between companies at the same level in the value chain) are typically described as being between competitors within an industry (e.g. Burgers *et al.*, 1993), and are not thoroughly described in relation to alliances between companies, which are not direct competitors. Despite the overweight of research in vertical alliances, however, research has indicated that disregarding the formal relationship between the parties, the motives for entering into co-operation may

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be generalised to some extent (Fritsch and Lukas, 2001). Some of the literature takes a more general approach, focusing on the role of partner involvement in product development (Crawford, 1992; Hagedoorn, 2002; Kelly *et al.*, 2002), comparing different aspects like motives for entering product development alliance relationships and organizational trust in vertical vs horizontal relationships (Fritsch and Lukas, 2001; Rindfleisch, 2000) etc. This paper examines the applicability of previous findings, related to different aspects of product development alliances, in the food industry; more specifically focusing on factors influencing formation and success of such interorganisational arrangements.

In the literature search, it was possible to group most of the identified factors as relevant for either formation or success of product development alliances, furthermore adding a group of contextual factors related to industry and company characteristics. The alliance formation factors were related to motivations and risks, which influence a company's choice of whether to enter an alliance or not. The alliance success factors related to product development alliances are constituted of the enablers (and barriers) of the success of the alliance once it has been established. Finally, the contextual factors are the predisposing industry and company attributes, which shape a player's willingness to enter into alliances and the behaviour within an alliance.

One factor important for alliance formation, strong social position of firms (generating personal relations between partners, status, reputation, trust etc), as described by Eisenhardt and Schoonhoven (1996), was of a different nature than the rest of the motivations and risks. This indicated that, apart from external formation factors (motivating through product advantages etc.), internal formation factors (inherent to the company) were also present. Formation factors will primarily be relevant for the individual company, while success factors are related to the relationship between alliance partners. The contextual factors influence both the individual company prior to alliance formation as well as the alliance partners in their efforts to establish a successful relationship. Table I presents the identified factors as well as key references. Further details and examples related to the factors, found to be of specific relevance for product development alliances in the food industry, will be presented and discussed in relation to the results.

Relevance of framework to product development alliances in the food industry

Product development alliances in the food industry have, as mentioned, not been subject to much scholarly attention. A few studies consider the broader concept of strategic alliances. Fearne (1994) analysed alliances in the European food industry, reporting an expected rise in interorganisational arrangements. The author states several advantages of entering into alliances, such as responding better to food safety and traceability legislation as well as changing consumer demands. Especially horizontal alliances are emphasised as a means of increasing the speed and quality of product development. Cante *et al.* (2004) conclude that strategic alliances in the food industry are primarily used to support vertical integration. Specifically in relation to product development alliances, Van der Walk and Wynstra (2005) examined the potential of supplier-buyer relationships within the food industry and found a big potential, with one of the major advantages being increased product quality.

One possible reason for the low mentioning of product development alliances in the food industry is that companies have not previously been motivated for entering into

			Product development alliances
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Formation	<p>Motivation: knowledge sharing – gaining access to new resources, knowledge, staff, equipment, etc</p> <p>Motivation: decreased development costs and time, shared economic risk</p> <p>Motivation: flexibility</p> <p>Motivation: technology complementarity, strengthening basic or applied research</p> <p>Motivation: inimitability</p> <p>Motivation: meeting new and complex market demands</p> <p>Motivation: overcoming vulnerable strategic position (emerging markets, innovative technology, high industry competition)</p> <p>Motivation: strengthening own brand</p> <p>Motivation: strong social position (personal relationship, status, reputation of firm and key individuals)</p> <p>Risk: lack of control</p> <p>Risk: opportunistic behaviour by partner</p> <p>Risk: gaining a competitor</p>	<p>Grant and Baden-Fuller, 2004; Ryan <i>et al.</i>, 2004</p> <p>Bonaccorsi and Lipparini, 1994; Eisenhardt and Schoonhoven, 1996; Hagedoorn, 1993</p> <p>Ryan <i>et al.</i>, 2004</p> <p>Hagedoorn, 1993</p> <p>Carmeli, 2004</p> <p>Hagedoorn, 1993</p> <p>Eisenhardt and Schoonhoven, 1996</p> <p>Sengupta, 1998; Venkatesh <i>et al.</i>, 2000</p> <p>Eisenhardt and Schoonhoven, 1996</p> <p>Cante <i>et al.</i>, 2004</p> <p>Ryan <i>et al.</i>, 2004</p> <p>Ryan <i>et al.</i>, 2004</p>	
Success	<p>Communication – breaking down barriers of e.g. culture and supporting a high degree of knowledge sharing and coordination of activities and goals among partners</p> <p>Commitment – to the relationship and offering mutual support</p> <p>Trust</p> <p>Selection and evaluation of partner, complementarity of resources</p> <p>Previous experience with product development alliance, having overcome the initial hurdle</p> <p>Joint teams</p>	<p>Appleyard, 2003; Crawford, 1992; Evans and Jukes, 2000; Kelly <i>et al.</i>, 2002; Mohr and Spekman, 1994;</p> <p>Bonaccorsi and Lipparini, 1994; Mohr and Spekman, 1994</p> <p>Mohr and Spekman, 1994</p> <p>Ryan <i>et al.</i>, 2004</p> <p>Bonaccorsi and Lipparini, 1994; Harrison <i>et al.</i>, 2001</p> <p>Fritsch and Lukas, 2001</p> <p>Cante <i>et al.</i>, 2004</p>	
Context	<p>Technology level of sector – in high-tech sectors, products are too complex to handle in-house and new technologies are frequently introduced. In low-tech industries, co-operation is primarily used as a means to access new markets</p> <p>Company size – co-operation on research and development is more likely to take place in larger companies (more than 200 employees), and with a high proportion of R&D staff</p>	<p>Evans and Jukes, 2000; Kelly <i>et al.</i>, 2002; Mohr and Spekman, 1994; Hagedoorn, 2002; Ryan <i>et al.</i>, 2004</p> <p>Fritsch and Lukas, 2001</p>	

Table I.
Theoretical findings on factors influencing product development alliance formation and success

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product development alliances, as they largely have possessed the necessary development and production competencies in-house. As discussed, the demand for more complex products can motivate food companies to form relationships, e.g. of a horizontal non-competitive nature, with other food companies. Product development of food products has to consider that food products consist of biological material, which changes over time and interacts with its surroundings. Developing products such as a meal will therefore require integration of component-specific knowledge to ensure end product quality (Van der Valk and Wynstra, 2005). Although food products are not necessarily as complex component-wise as more high-tech products (e.g. computers or automobiles), the activity of product development may still represent a complex task that requires input from several partners.

The contextual factors mentioned in Table I, size and technology level, underline the need to examine the applicability and sufficiency of the identified factors influencing formation and success of product development alliances specifically in the food industry. The food industry features special characteristics precisely in relation to size and technology level. The food industry is characterised by a very high percentage of small- and medium sized enterprises (CIAA, 2006), partially because of the ease of setting up a new company in the food industry. Following Porter (1979), barriers of entry are low: economies of scale is not necessarily a barrier of entry for SMEs (depending on their product line), there are relatively small capital requirements, a good possibility of stimulating product differentiation, low cost disadvantages, differentiated distribution channels (e.g. national for larger companies vs regional for SMEs) and low barriers related to government policies. However, increased competition from a broader scope of companies, both product wise and geographically, can change the industry conditions and motivate companies to build and protect their competences as well as market position better. Furthermore, the food industry is traditionally not thought of as a high-tech sector (Hagedoorn, 1993); R&D expenditure is low (Grunert *et al.*, 1997; Avermaete *et al.*, 2004), and although there is a focus on process optimisations and innovations related to this, radical product innovations are rarely seen (Costa and Jongen, 2006). Thus, companies have to pursue other avenues of creating products with unique value. Johansson and Elg (2002) suggest interorganisational relationships as a means of raising barriers of entry, thus assisting the support of a competitive advantage.

Thus, the theoretical framework provides a relevant point of departure for the empirical research performed in this study. The tradition for vertical integration is well established in many parts of the food industry (Søgaard, 1994; Cante *et al.*, 2004) and the factors identified in the literature are therefore expected to be relevant in this context to a large degree. New factors, specific to the food industry are also likely to be added.

Methodology

Based on the theoretical framework, it was sought to obtain empirical data, which would supply information both on factors influencing individual companies prior to product development alliance formation, as well as factors related to the success of the alliance, once established. Furthermore, the applied methodology should allow confirmation of the theoretical factors and categories, and also be open to the addition of supplementary factors. The methodology should therefore be of a qualitative nature,

but still provide enough information to establish propositions about product development alliances specifically related to the food industry, as well as point to future avenues of research. It was therefore chosen to combine an in-depth exploratory case study of a product development alliance in the food industry with a small-scale survey including semi-structured interviews with product development managers, covering the food industry broadly, on product development alliances. The case study served as an initial test bed for analysing the applicability of the theoretical findings in the food industry and for identifying new factors. The interview survey served to challenge the results from the case study and to further develop the framework by adding a more general (but still exploratory) view on product development alliances.

Exploratory case study

The case study was performed during a one-year period, ending in the summer of 2004, following four companies within different branches of the food industry (meat, vegetables, dairy and bread) and of different sizes (the meat producer was large, the others SMEs). The partners started a product development alliance with the goal of putting a healthy meal solution for consumers “on-the-go” on the market. The companies had not worked together before. The project group consisted of a representative from each company, with different backgrounds, and initially also a representative from a customer, who had shown an interest in selling the products. Three of the company representatives were middle managers, while the fourth was CEO of the smallest company. One of the SME middle managers took on the role of project management.

The method used was participatory research, observations and interviews. The unit of analysis was the alliance, not the individual companies. The research included participation in all project meetings and access to a large amount of written and oral communication, but no active involvement in product development alliance activities. After this phase, a case report was written. This was followed up by one-hour individual semi-structured interviews with the company participants in the project group (four informants in all). Informants were asked to describe the development process and factors related to the formation and activities of the alliance, loosely structured around the theoretically identified factors described in the previous section. Interviews were recorded and transcribed. Factors of relevance to the confirmation and/or development of the framework were extracted from the interviews in the following analysis. A summary of the case report as well as over-all findings of factors influencing the formation and success of the alliance was sent to each of the informants for comments.

Interview survey

Potential informants were identified to provide a cross-industry picture of factors of importance to product development alliances. Companies were therefore chosen to include both different sectors (meat, dairy, vegetables, bread, ingredients, packaging) and company sizes (both national SME's and larger international firms) in the study. Medium-length semi-structured interviews with one key informant from each participating company were performed. As described by Kvale (1994), suggestions for themes and specific questions were developed prior to the interview in more detail than necessary for most informants, but the interviewer was open to let the informant guide the conversation, which could produce a change in the order of the questions as well as

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an introduction of new topics. The interview guide was structured around the factors identified in the literature, including the new factors uncovered by the case study.

Key informants were chosen to be vice presidents of R&D or persons with a comparable position within the firm. These persons have much knowledge about the firm, its strategic environment and product development alliance activities (Link and Bauer, 1989). Key informants were identified in 24 companies, contacted by mail and followed up by phone to set a date for the interview. Five of the small companies (including the two smallest) declined because of time constraints. The 19 remaining companies participated in the study, representing both the different company sizes and sectors present in the food industry. Key informants held positions of product development managers, sales vice presidents, sales managers, managing directors and quality managers and were all responsible for product development activities.

Informants were interviewed personally (six informants) or by phone (13 informants) for 45 to 60 minutes by the same interviewer (the first author of this paper). The interviews were carried out in the course of six weeks, finishing in the spring of 2005. The informants were given information beforehand that the interview would focus on co-operation, specifically in relation to product development. Each informant was encouraged to participate in developing the conversation and the interviewer tried to ask as few questions as possible, while ensuring that the main subjects in the interview guide were covered. Interviews were recorded and transcribed, except four (because of technical issues). Thorough notes were taken during and after the interview session. Interview results were coded on the basis of the factors provided by the theoretical frame of reference as well as new additions from the case study, and new relevant elements were identified. All participants received a summary of the main results of the study.

Results

While the case study portrayed a horizontal, non-competitive alliance between food processing companies at the same level of the meal production chain, the interview survey revealed other interpretations of the concept of product development alliances. All the companies participated in product development alliances, ranging from primarily transaction based vertical relationships to more development oriented horizontal relations. All of the informants had vertical inter-firm relations with suppliers and customers related to single components, whereas cooperation was less outspoken for complex products and working with other producers of complementary products. Non-competitive horizontal alliances, however, were mentioned several times as a future form of cooperation. All informants believed that they would participate in more product development alliances in the future, because consumers were demanding more complex products and also being threatened by the entrance of foreign competitors with comparable competences, but offering lower prices.

A framework for product development alliances in the food industry

The four informants in the case study agreed to the identified factors, sharing a common story, while factors from the interview survey illustrated a much greater variance in attitudes. Both the case study and interview survey added new perspectives to the literature in relation to factors influencing product development

alliances in the food industry. The new factors added to the framework are listed below:

Formation:

- *Spin-off projects (case study and interviews).* It was considered a major motivating factor that product development alliances could generate spin-off projects either with the same partner or new ones through the partner's network, to, e.g. access new markets.
- *Publicity (case study).* Good publicity was emphasised by the informants in the case study, where the developed products should fulfil specific nutritional goals to be able to offer a healthy alternative to other "on-the-go" products.
- *Exclusion (interviews).* A risk of product development alliance not mentioned in the literature was the risk of committing too much to one partner. This implies a risk of exclusion from product development alliances with other parties within that partner's branch of the food industry or even exclusion from working with specific customers, if they did not want to co-operate with the chosen partners.
- *Innovation strategy (case study and interviews).* It was found crucial that the product development alliance project was in line with the company's strategy to ensure product development alliance success.
- *Culture (case study and interviews).* The culture of the company influences the approach to alliance formation significantly. In the case study the companies were very different in terms of the way that they had been started and in terms of the markets they usually dealt with. They subsequently placed different importance on issues such as flexibility, customer relations, production capabilities, etc. The interview survey disclosed that two informants from companies of approximately the same size and both producing relatively complex products requiring involvement of various suppliers entertained almost opposite attitudes towards developing close relationships with partners. One had a culture that was based on being innovative and therefore did not consider the risk of opportunism relevant. The other company had a relatively slim product portfolio and wanted to focus on the core products, which also meant that their openness towards product development alliances was at a minimum.
- *Market development perspective (case study and interviews).* Expectations of the future market development influenced attitudes towards product development alliances, where some found it crucial to use them as a tool to respond to new demands and others were more sceptical, e.g. about the magnitude of the convenience trend, and thus more confident that they should maintain a higher level of independence. The connection between new market development and alliance formation is also in line with Hagedoorn (1993).

Success:

- *Equality (case study).* The case study illustrated a horizontal alliance of non-competing partners, which was further reinforced by the fact that the participants gave priority to equality in decision-making.
- *Spending to gain (interviews).* The commitment to product development alliance also had to include an acceptance of spending more to gain more.

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As illustrated in Table II, where the entire set of factors are presented, all but three of the theoretically identified factors were also found in one or both of the empirical studies. The factors not found were the formation factors “gaining a competitor” and “technology complementarity” as well as the contextual factor “industry technology level”. The indication from the literature review that formation factors could be both external and internal was further emphasised in the food industry, with several additions to the latter sub-category.

Apart from confirming some of the more universal formation and success factor of interorganisational relationships, such as knowledge sharing, communication and commitment, other factors were mentioned in a more industry specific context. In the following these factors (highlighted in italicised letters) will be described.

In the literature based in the food industry, *increased product quality* is mentioned as a major motivating factor for product development alliance formation, which is natural since quality is an important determinant of purchase of food products (Grunert *et al.*,

		L	C	I
<i>Formation (external)</i>	Knowledge sharing	×	×	×
	Decreased development costs and time	×		×
	Flexibility	×	×	×
	Technology complementarity	×		
	Inimitability	×		×
	Meeting new and complex market demands	×	×	×
	Overcoming vulnerable strategic position	×		×
	Strengthening own brand	×		×
	Lack of control	×		×
	Opportunistic behaviour by partner	×		×
	Gaining a competitor	×		
	Increased product quality	×		×
	Spin-off projects		×	×
	Publicity		×	
	Exclusion			×
<i>Formation (internal)</i>	Strong social position	×		×
	Innovation strategy		×	×
	Culture		×	×
	Market development perspective		×	×
<i>Success</i>	Communication	×	×	×
	Commitment	×	×	×
	Trust	×	×	×
	Partners, complementarity of resources	×	×	×
	Previous experience	×		×
	Joint teams	×	×	
	Equality		×	
	Spending to gain			×
<i>Context</i>	Technology level of sector	×		
	Company size	×	×	×

Table II.
Overview of the
framework for factors
influencing formation
and success of product
development alliances in
the food industry

Notes: As identified in the literature (L), case study (C) and interview survey (I), *food industry reference

1996). This factor was also mentioned in the interviews. Furthermore, the interview survey revealed that an expected future *vulnerable strategic position* in relation to emerging markets and competition influenced the informants' intentions to enter into alliances positively. Market development also spurred interest in achieving *inimitability* of more complex products through establishing product development alliances with complementary companies. Also, the companies would enter into alliances to protect themselves from international competitors selling standard products at lower prices than Danish producers.

In relation to the contextual factors, *company size* seemed to have an important influence on product development alliance activities. In the case study, one of the companies was much larger and behaved differently than the others. For instance it had a more rigid internal organisation and more time-consuming decision making. The smaller companies were more flexible, but, on the other hand, they were also less systematic in their work processes. This was also supported by the findings in the interview survey, especially with regards to formal agreements with partners, which were more widespread in the larger companies. The extent to which product development alliances were undertaken did, however, not seem to be as closely correlated with company size as described in the literature.

Discussion

The factors found to influence product development alliance formation and success in the food industry generally follow the literature on alliances as such, e.g. highlighting the importance of knowledge sharing, trust, communication and commitment. The newly added factors stem from the specific characteristics of the food industry, where the tradition for product development alliances has not yet been established, and where companies are not forced by external conditions to engage in such activities. In other industries inter-firm relations can be crucial to selling any products at all (as in the automobile industry, where components are inter-dependent) or for developing common new technologies (as in, e.g. the computer industry). Without strong external pressure, motivations have to be stronger or risks smaller for companies to enter alliances. When, as (at least until now) it is the case in the food industry, companies have a somewhat free choice of entering alliances, this can generate a more critical view on such activities, e.g. opening up for companies to worry about risking exclusion from working with other potential partners if they work too closely with one specific company. They can furthermore choose alliances on the basis of advantages gained such as good publicity or they can choose specifically not to use them because of the implicated risks. Product development alliances can be established with partners, which are not direct competitors, because partners act in different raw materials markets and have complementary resources in relation to, e.g. the market for meal solutions. They furthermore do not have to worry about competition among partner and can place demands on the alliance such as the possibility of spin-off projects and equality in the decision-making process. This may change with the realisation of new market demands, putting more pressure on companies in the food industry to combine resources.

It seems that the uncovered internal formation factors have an important influence on attitudes towards product development alliances in general. This both in relation to products and company tradition, and also in the way that the stronger the focus on innovation, the easier it will be to acknowledge the advantages of co-operation.

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Because this research was performed within the boundaries of a single industry, it was not possible to draw conclusions about the influence of technology levels on alliance activity differences between firms. The lack of support for the formation factor “technology complementarity” in the food industry, however, underlines the effect of this contextual factor, in correspondence with Hagedoorn (1993), who came to the same conclusion when comparing sectors of different technology levels.

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There was much variety in the interpretation of what a product development alliance was. Generally, product development alliances in the food industry seem to be primarily related to vertical partner relationships with suppliers and customers. It is interesting because it indicates that food companies are used to think about vertical, not horizontal, relationships in product development, and that some companies may even lack the ability to imagine entering into product development alliance of complex products. This is consistent with earlier findings that product development alliances are more common in high-technology sectors than in sectors such as the food industry. It can, however, also be a characteristic of an industry, which is just beginning to face a demand for more complex products, i.e. an “emergent market”, as well as increased competition to fulfil these demands. These are both elements of a “vulnerable strategic position”, a motivation factor for alliance formation described by Eisenhardt and Schoonhoven (1996), which can thus gain more importance in the future.

Managerial implications

The developed framework offer a potential for facilitating processes related to product development alliances within a company, such as strategy, screening of potential partners and decisions on involvement in concrete projects. Once an alliance is formed, it can also serve as a tool for aligning expectations between partners, setting goals, improving communication, organising the work, facilitating continuous evaluation and adjustments etc. The identified factors will be subject to the company-specific context and individual interpretations, which further underlines the importance of discussing them both internally and among partners. Formation and success factors are interconnected, as an example a company-internal assessment of the risks inherent in a specific project may qualify the discussion of success factors, pinpointing the specific issues which have to be emphasised in the alliance. Furthermore, it is important to be conscious about contextual factors, especially size (and the organisation, decision-making etc. which follows).

Product development alliances potentially offer a competitive advantage to food companies, because they will be better able to respond to changing consumer demands and furthermore new products will require more knowledge and resources to copy by competitors. Food companies often act in business-to-business relationships, distributing their goods as well as communicating through intermediaries. By focusing more on the end product, not just individual components, in product development alliances, the direct relationship with customers and consumers may be strengthened and flexibility and variation in relation to product offers optimised, e.g. by applying the principles of mass customisation (Gilmore and Pine, 1997). The combination of mass production with end-user customisation will also be a natural path of building on the process focus which traditionally characterise food producing companies.

The results emphasise the need for a growing awareness of the factors influencing formation and success of product development alliances in the food industry, also in

the light of the expected increase of such interorganisational arrangements. Furthermore, there is a potential in establishing horizontal relations focusing on developing complex products, such as meal solutions. If product development alliances take place between companies within different parts of the food industry, the parties will, in principle, be non-competitive, and therefore have a good starting point for developing a win-win situation by combining meal components. By integrating their resources in the product development phase, the involved companies may be able to offer products of higher quality, which are harder to imitate by competitors as well as being easier to customize by the alliance partners than earlier food products offerings on the food market.

Conclusions and further research

The factors identified theoretically in the general alliance literature were broadly confirmed and new factors specific to product development alliances in the food industry added. The framework uncovers a high degree of complexity related to formation and success of these interorganisational relationships, both represented by the number of factors as well as their potential interactions. The nature of the differences between the developed framework for product development alliances in the food industry and theory on alliances in general, indeed seem to rest in the chosen specific context. Companies in the food industry are not forced by external conditions to enter into product development alliances. Therefore, compared to other industries, motivations have to be stronger or risks smaller for them to form such interorganisational relationships. However, once formed results indicate that success factors are more universal across industries and types of alliances. Changing consumer demands as well as increased competition are changing the conditions of the industry, which motivates companies to engage increasingly in product development alliances and also potentially change their focus regarding formation and success factors in the future.

This research provides managers in the food industry a frame of reference for evaluating whether they should enter into product development alliances and what pitfalls to avoid and success factors to strengthen. As the results are exploratory findings, a weighting of the factors in the developed framework has not been performed, this requires further quantitative research in the food industry context. Considering the changing market demands, a longitudinal study would be of great interest; it could therefore also be relevant to examine the importance of formation and success factors related to product development alliance among companies in countries where complex food products are more prevalent. This could for example be done in the UK or USA. Furthermore, testing of the framework in other sectors characterized by, e.g. different technology levels, would give valuable insights on the significance and role of contextual factors.

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3.4 A typology for product development alliances in the food industry

In addition to the framework for product development alliances in the food industry presented in paper B, the present thesis also reflects on the wide span of inter-organisational activities that the informants mentioned. Product development alliances from a food producer's perspective take many forms of upstream, downstream or horizontal relationships with other partners within the food industry. The common denominator, as argued earlier, should be to keep the end product in mind and fulfil consumer demands in relation to this, independently of how the transaction scheme is structured. In the following, a typology of product development alliances in the food industry is suggested (see Figure 3.1) and examples from the interview survey and other industry observations are given.

Following Hagedoorn (1993), it is argued that forming inter-firm relationships and meeting new market demands are interrelated, especially in low-technology sectors and mature markets (such as the food industry). Grant & Baden-Fuller (2004) give an example of one kind of relationship, where products are complex and require different competences. This type of relationship is placed in the upper right corner of the Figure. The lower left corner represents a traditional transactional supplier / buyer relationship. Going from transaction to product development alliances and from component to complex products, hybrid categories will also exist. One of the most important antecedents of success in inter-firm relationships is trust (Mohr & Spekman, 1994). Trust can be gained through increased interaction (Millson & Raj, 1996), corresponding to the development on the y-axis "partner interaction in NPD" (new product development) from transaction over dialogue to cooperation. Similarly, relationships between several partners can also evolve over time, e.g. starting with two companies combining their products to form part of a meal solution. This corresponds to the development on the x-axis "end product complexity" from components, through component combinations to meal solutions.

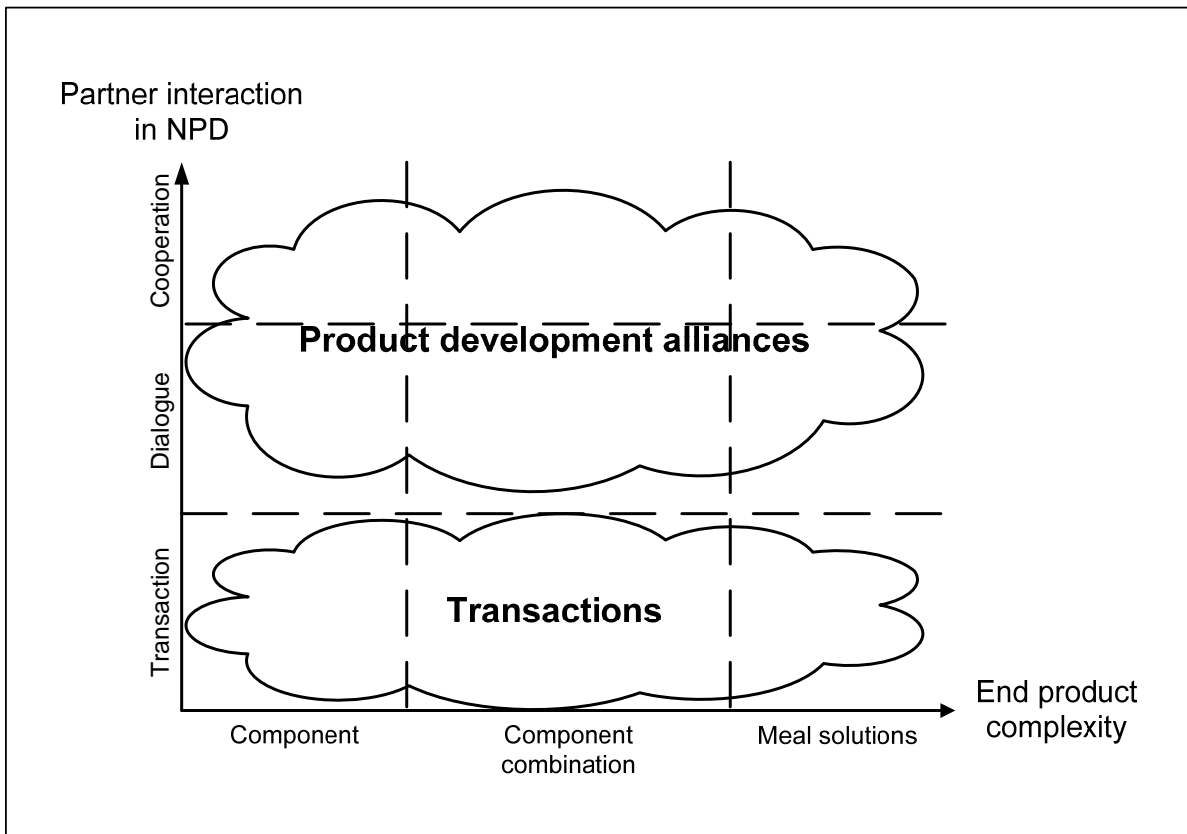


Figure 3.1. Illustration of typology for product development alliances in the food industry.

3.4.1 Examples of product development alliances

In the interview survey, examples of alliances within many areas of the framework were identified. There was an overweight of examples in the bottom layer of the Figure (especially the lower left corner) and only few examples in the upper right corner. Although only the middle (dialogue) and top (cooperation) horizontal layer of the Figure actually fall under the definition of product development alliances, it is interesting to note that different kinds of transactions were often mentioned by the informants as examples of cooperation on product development. A dialogue about product development activities (the middle layer) is typically initiated by the actor who has direct customer contact, drawing on interaction with suppliers when relevant. Examples of alliances in the top layer are characterised by more direct interaction and mutual ownership in the product development process than alliances in the lower layer. In the following, the different categories in the typology are exemplified through recent observations, primarily from the Danish food industry.

- **Transactions.** Typical buyer-seller relationships based on supply of ingredients according to specifications. All informants mentioned this kind of relationship (especially in relation to single components), which implies that it is the traditional approach to inter-firm relationships in the food industry. An example of this type of relationship in the case of meal solutions is retnemt.dk, which offers home delivery of recipe and ingredients for a meal (retnemt.dk, 2008). Also DreamDinners is worth mentioning; an American “meal assembly store” where ingredients and recipes are prepared beforehand (Dreamdinners, 2008).
- **Dialogue - components.** Inter-firm product development relationships where suppliers and producers have a relatively formal connection. Producers typically have exact specifications for the ingredients that they need, but can use the inspiration from suppliers to get ideas for new product development and can also invite suppliers to take part in the early phases of product development. As an example, the Danish dairy Naturmælk delivers whole milk to the Danish bakery Kohberg, and both brands are used in marketing of a whole-milk bread (Naturmælk, 2008).
- **Co-operation - components.** This type of relationship is more obligating than types 1 and 2; development activities are more integrated and costs related to e.g. new equipment, employee time, etc., are covered by both parties. The relationship is in focus, the goal is to develop it on the basis on openness and trust. The relationship is still typically vertical in nature, although joint ventures also do exist. An example of the latter is the company Gourmet Danmark, which started as a producer of speciality mustards in cooperation between two Danish food producers, and where product development is performed jointly (Gourmet Danmark, 2008).
- **Dialogue - component combinations** This kind of relationship draws advantage from each partner’s knowledge about e.g. physical properties, consumer preferences and new trends related to their component. Cooperation between five Danish food producers within the frame of the publically funded “food in movement” project resulted in several product offerings in sports facility cafeterias under the heading “Move’n eat” (Mad i bevægelse, 2008). The concept is primarily based on existing products in new combinations.
- **Co-operation - component combinations** As in type three, development activities are becoming more integrated and both parties cover a part of the development

costs. Because the end product is component combinations, the parties gain access to knowledge outside their own product domain through the relationship. Bready, for example, is a series of convenience bread products with filling, ready to heat and serve. Some of the variants have been developed in cooperation between the bread producer Easyfood and its partner Kraft Foods. The two partners have a history of joint development of concepts for the food service sector (Easyfood, 2008).

- **Dialogue - meal solution** This type of relationships can include co-promotional activities and shared recipe development based on existing components or integration of supplier knowledge on a one-to-one basis with the customer. For example, “1-2-3 skolemad” supplies food to a wide range of Danish schools and cooperates with many different suppliers who are involved separately in product development as needed (1-2-3 Skolemad, 2006; 1-2-3 Skolemad, 2008).
- **Co-operation-meal solution.** The relationship between producers is typically horizontal. Concepts are developed together and maybe even sold under a common brand, components can be newly developed within the relationship and knowledge related to products, production and markets are used actively. The case described in Paper B (p. 435) is an example of such cooperation.

3.5 Perspectives of meal development alliances

When focusing on meal solutions, it is relevant to consider if the scope of product development alliance activities can be narrowed in to one of the areas within the presented typology. The results presented in paper B indicated that alliance activity in the food industry is mainly vertical, focusing on supplier-customer relationships related to core products. However, as we see a development in the market needs with growing focus on quality and variation of complex products such as meal solutions, as described in Chapter 2, product development alliances – or rather, meal development alliances (the upper right corner of the figure) - seem to become more relevant, see Figure 3.2. Meal development alliances are defined as: *inter-organisational arrangements, in which food producers jointly develop meal solutions based on components that will be marketed or sold together.*

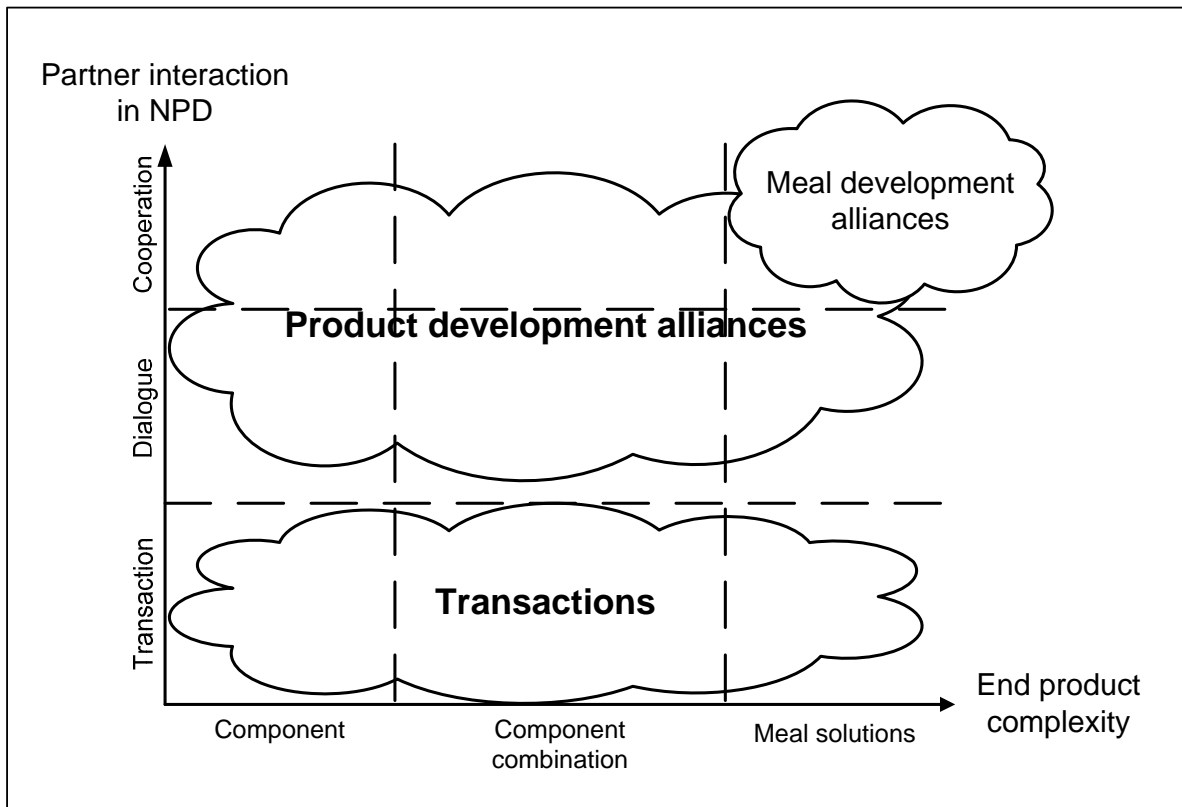


Figure 3.2. Position of meal development alliances in the typology of product development alliances

Food producers who wish to be able to respond to the changing eating habits need to broaden their perspective on what their end product is and will be in the future. The focus will have to shift from meal *components* to meal *solutions*. In this context, meal development alliances may be a relevant tool for two main reasons: 1) meal development alliances can empower food producers to take charge of the quality of end products (meal solutions) as a whole, instead of considering the meal as just representing an assembly of individual components, and 2) if meal development alliances are formed between companies within different parts of the food industry, the parties will, in principle, be non-competitive, and, therefore, have a good starting point for developing a win-win situation. The effects of entering into meal development alliances can also be illustrated as a mediator in the quality cycle whereby the complexity of quality-focused meal development is reduced by using the end product – the meal solution – as a starting point for product development. Thus, quality goals among partners can be better aligned, both in relation to the meal solution as a whole as well as its constituting components. This is illustrated in Figure 3.3.

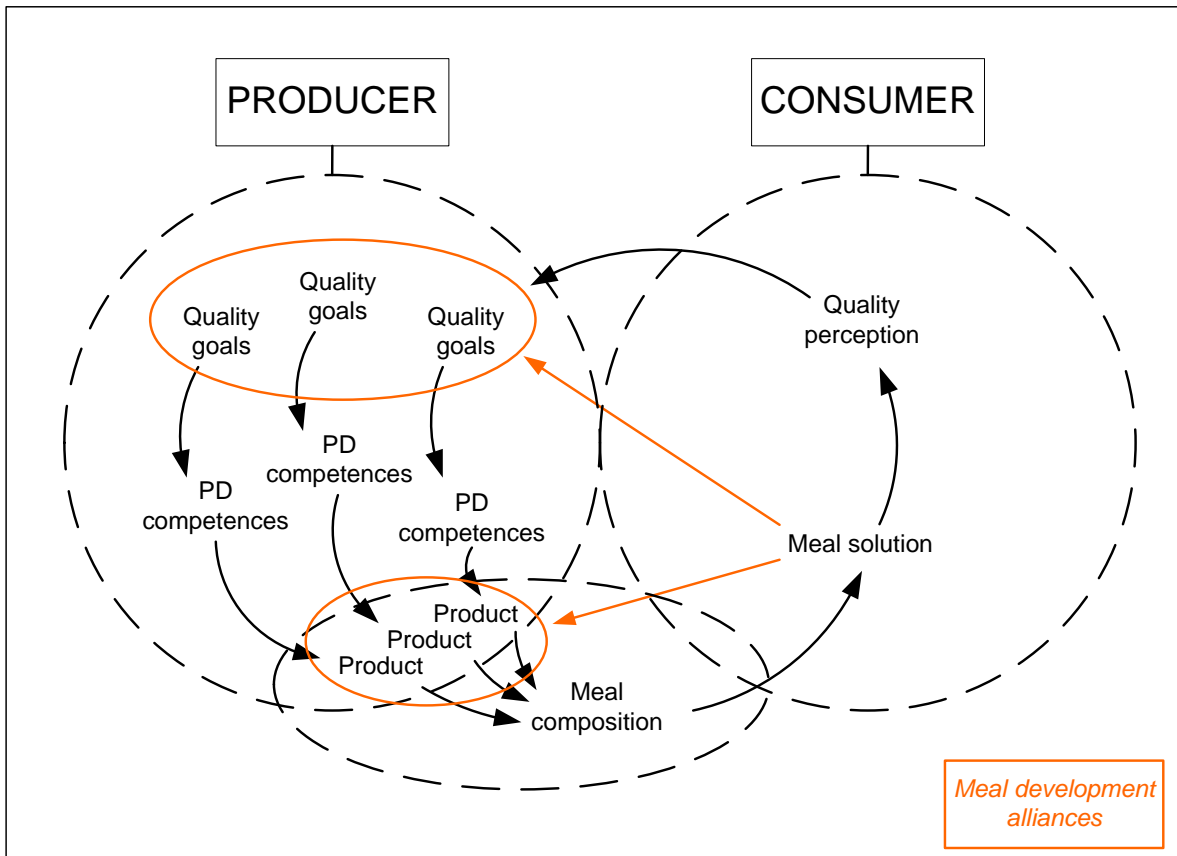


Figure 3.3. Potential effects of meal development alliances illustrated in the quality cycle. PD: product development

As discussed in the paper, food producers do not seem to use meal development alliances to a very high degree, which can be due to the fact that they have not been sufficiently encouraged, e.g. by market forces, to do so. Furthermore, the barriers to cooperation can seem overwhelming. When interviewed, one manager in a large Danish bread producing company stated: “these voluntary forms of cooperation can be very hard to handle”. A way to overcome some of the challenges of establishing strong communication and knowledge sharing, identifying complementary partners and increasing flexibility could be to mediate the translation of consumer demands to meal composition guidelines and specifications for meal components. Modularisation can act as such a mediator and this will be discussed further in Chapter 4.

3.6 Conclusions and implications

Addressing research question B, this chapter has focused on the initiation and success of product development alliances and their potential for facilitating quality improvements of meal solutions. Product development alliances have been shown to be relevant in the food industry in many constellations. Furthermore, factors influencing the formation and success of such activities in the food industry have been uncovered. The typology for product development alliances was used to illustrate the relevance of cooperation between producers with complementary competences with a view to meet market demands related to meal solutions. Such alliances were termed meal development alliances.

For managers in the food industry, the results imply that product development alliances can act as a tool for supporting competitive advantage through improved quality for the customer. However, barriers to entry into such inter-organisational arrangements also exist and it is crucial for food producers to ensure that invested resources (people, money, time) match the outcome of a relationship (product value and demand). A possible way to reach this goal is by focusing on communication when initiating the alliance, by discussing mutual expectations and setting goals for the outcome and the cooperation, as well as evaluating these points throughout the product development process. The developed typology is a relevant tool in strategy discussions about a company's position and future goals - there is no one ideal position, only a benefit of being aware of where a company finds it self currently and where it strategically is headed.

Further research should focus on quantitative validation of the framework. Also, the developed typology can be further developed, both quantitatively and qualitatively, e.g. by performing case studies on meal development alliances.

4 MEAL MODULARISATION

This chapter discusses the challenge of translating consumer requirements into specifications for both meal solutions and components in the light of the principles of modularisation. Paper C suggests a specific modularisation approach to meal composition. The concept of meal modularisation is introduced and its mediating role in the quality cycle is discussed. Furthermore, the issue of mass customisation as a benefit of meal modularisation is raised. The main research question posed in this chapter is:

RQC: Can modularisation facilitate quality improvements of meal solutions and, if so, how?

As mentioned previously, it is important to ensure that products delivered to the consumer fulfil changing and, to a certain degree, intangible quality demands. The concept of consumer-led product development represents a potential strategy for focusing more on consumer needs in the product development process. It deploys consumer needs as its starting point in the product development process Costa & Jongen (2006). However, the authors highlight that concrete guidelines for implementing this strategy in everyday industry practice are yet to be developed. Product development of meal solutions needs to address an important challenge because quality demands typically target the meal solution as such - not individual components. Suppliers in the food industry, who are typically responsible for only part of the meal, would therefore benefit from access to a tool that could reliably translate consumer demands into tangible specifications for the components making up the end product. The following section will present some methods described in the literature for such translation.

4.1 Translation of consumer demands into product specifications

Quality Function Deployment (QFD) consists of four different matrices to translate consumer requirements into process step specifications (Cristiano et al., 2000). The first matrix, the House of Quality (HoQ), is used to support product development in many industries and takes the first step from consumer demands to product characteristics with a view to improving existing products or developing new ones (Hauser & Clausing, 1996). The HoQ has traditionally been used to support development processes in ship building, the

car industry and electronic industries (Akao, 1990). For food products, HoQ has been used in a more or less standardised form to improve products and also in relation to new product development. The method has been used to translate consumer requirements into both technical and sensory characteristics of e.g. peas and chocolate [Bech et al., 1997; Viane & Januszezewska, 1999]. Benner et al. (2003b) attempted to apply the HoQ in relation to quality improvements for a ready-made meal with health benefits. The authors conclude that QFD has to be altered to fit the specific characteristics of food product development, because processing is not taken into consideration – *“the final quality of the product is not only dependent of the quality of the ingredients”* (p. 338). Furthermore, they note that quality improvements are even harder to establish with this method because product complexity increases and so does the interactions between components, which is exactly the case for meal solutions.

Building on this insight, Benner et al (2003a) presents the chain information model, which is based on some of the principles of QFD. The method aims at improving the features of existing products emphasised by consumers. The method relates product quality characteristics to actors in the production chain by building scenarios for each actor. These scenarios outline the effect of different choices of raw materials, processing, composition, etc., on over-all product quality and hence provide the ground for proper evaluation of relevant alternatives. Their work offers a valuable perspective on the whole production chain by making it more likely that the product reaching the consumer has the intended quality and by offering a coherent model for consideration of multiple, relevant factors in the interplay between actors and products. However, the method also has its challenges in relation to product development of new products and there is furthermore no mentioning of how the method could work in relation to complex products. The method has recently been applied with a view to making the relatively simple product tomato ketchup more healthy. Numerous scenarios were involved, which illustrated the challenges of applying this method to meal solutions (Benner et al., 2007).

Steenkamp & van Trijp (1996) present “Quality guidance” as a methodology complementing QFD with a view to improving the physical product in light of consumers’ demands. The authors make a distinction between “quality expectations” (at the point of purchase) and

“quality performance” at the point of consumption (which is in line with the distinction also made in the Total Food Quality Model (Grunert et al., 1996)), and they obtained consumer data on quality perception of a test product at both points. In their study, quality attributes (sensory) were also chosen on the basis of a literature study and consumer research, and then rated by a group of consumers. Ratings were related to measurable physical characteristics of the product. On the basis of this research, key physical parameters associated with optimisation of consumers’ perceptions of quality were identified. However, this method is only described as suitable for improvements of existing products, although it can probably also be applied to prototypes in new product development processes.

The described methods present possible approaches to translating consumer demands into product specifications, but are all faced with challenges when it comes to new product development of complex food products such as meal solutions. Generally, the methods are not sufficiently operational because they are either too complex or too general. To fulfil consumer needs, specifically in relation to meal solutions, a meal composition approach may be more instrumental, as described in paper C. The literature review presented in paper C shows that the quality focus in meal composition studies is often either too narrow in the sense that it seeks to satisfy consumer demands related to sensory product characteristics only, or it is too conceptual to be used for development of specific meal solutions. Modularisation offers an alternative, so far unresearched approach to meal composition and will be considered below.

4.2 Modularisation of meal solutions

The challenge remains how to develop meal solutions at a concrete product level in a manner that adopts a holistic approach to consumer quality requirements while being sufficiently specific to deliver specifications for the individual modules forming part of the meal. Modularisation - *“...building a complex product or process from smaller subsystems that can be designed independently yet function together as a whole”* (Baldwin & Clark, 1997, p. 84) - has the potential to meet these challenges. The approach has not yet been applied to development of food products but fits well into the context of meal solutions as one of the basic approaches to the end product is to consider it as consisting of several modules that typically come from individual suppliers. See paper C for a literature review.

Some considerations specifically address the differences of modularising food products such as meal solutions compared to typically modularised products such as computers, cars and electronic equipment, as there is no dominant design and furthermore interactions (rather than interfaces) play a major role.

- A dominant design is an empirical construct, defined by Anderson & Tushman (1990, p. 613) as *“a single architecture, which establishes dominance in a product class”*¹². Dominant designs are empirical phenomena, *“...recognized post hoc, based on subjective guidelines”* (Gallagher, 2007). For meal solutions, no dominant designs seem to have been established – there are no clear-cut rules specifying which types or how many modules should form the basic elements of a meal. Dominant design in relation to food has not been much discussed in the literature. Early examples are related to single component products and basic technologies such as soluble coffees, canned vegetables and pre-cooked rice (Abernathy & Utterback, 1978; Buzzell & Nourse, 1967), while more recent literature discusses functional foods (Nordström & Biström, 2002) and genetically modified foods (Labreque et al., 2007) as emerging dominant designs. The lack of a dominant design for meal solutions means that although the end product is significantly more simple than e.g. a car, the process of modularisation in itself can be rather complex. Challenges are related to e.g. how modules are selected, the degree of interchangeability and commonality of modules, how detailed interfaces can be / are specified, how large a share of the end product individual modules is assigned etc.
- The typical modularised products are made of stable materials with virtually no limits on shelf-life. In contrast to this, meal solutions and their components are biological material subject to changes in sensory, microbiological and other interactions between components, further processing, distribution, storage life and conditions, etc. These issues have to be handled when specifying modules and processing, and they represent a particularly vexing challenge to modularisation. However, in spite of the potential challenges, this characteristic of food product modularisation makes it particularly important to use modularisation principles actively, to ease the

¹² Baldwin & Clark, 1997 describes the architecture as the basic structure of a product, defined by modules and functions.

translation of consumer requirements to specifications of components, composition and processes.

Both of the above mentioned issues add new dimensions to the application of modularisation in the context of meal solutions. Paper C presents the Meal Composition Approach, which is based on modularisation principles. The paper adds a new perspective to extant literature on modularisation and meal composition. In relation to the issues specific to meal modularisation discussed above, a meal solution structure (dominant design) is chosen to depart from and the specific processes and interactions are considered in relation to the chosen case example.

4.3 The Meal Composition Approach (paper C)

The Meal Composition Approach – a new way of optimising the quality of foodservice products

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Abstract

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Keywords:

foodservice, meal composition, modularisation, quality

The objective of this paper was to introduce a new approach for foodservice professionals to compose meal solutions, with a focus on optimising the quality and variation of end products. Modularisation principles were used to develop the Meal Composition Approach, supporting the process of translating consumer requirements into meal composition, based on knowledge of component properties and interactions, as well as processing, a central aspect of food production. The approach consists of seven steps, which can be used at several levels as a framework to approach meal composition and consumer satisfaction in a systematic manner. This research fills a gap in the literature, describing a holistic approach to meal composition, which considers quality issues in relation to specific meals. Furthermore, modularisation has not previously been described in relation to food products.

Introduction

The foodservice industry is growing as an increasing number of meals are consumed outside the home, partly because of time scarcity among consumers (Costa *et al.* 2001; Jabs & Devine 2006). As a consequence of greater exposure and freedom of choice, consumers are demanding better quality, balanced nutritional value and a variety of meal solutions, because they have a tendency to form quality expectations and to compare the meal solution with home-made meals, and also to have a more positive attitude towards home-made meals in general (Cardello *et al.* 1996; Costa *et al.* 2007). At the same time, the foodservice industry is experiencing a move towards the centralisation of production of meals and meal components, and a more widespread use of partially prepared components (Mikkelsen *et al.* 2004). In hospital foodservice, for instance,

a study has shown such modernisation is related to an increased focus on technology and nutrition. The effects were increases in cook-chill over cook-hold technologies in the number of hospital kitchens receiving chilled foods from central production units, in the use of decentralised plating and/or buffets as well as in the number of skilled employees (Engelund *et al.* 2007).

Thus, foodservice professionals are constantly being challenged by consumer demands of quality and variation on the one hand, but can feel limited by production systems and supply opportunities on the other hand. A new approach to meal composition is needed, which can empower the foodservice professional to match consumer demands with meal solutions. In this paper, modularisation is used as a tool to facilitate meal solution composition, which fulfils consumer demands and offers variation, based on knowledge of meal component properties and interac-

tions. Modularisation is widely applied in high-tech industries, producing, for example, computers, electronics and automobiles, but the literature does not present any information on its application in the foodservice industry.

The objective of this paper is to introduce a new approach for foodservice professionals to compose meal solutions, which focus on optimising quality and variation of end products. This research adds to the literature on meal composition and modularisation. The paper is structured with an introduction, including a review of literature related to tools for meal composition as well as modularisation. The 'Meal Composition Approach (MCA)' is introduced and explored, and implications for foodservice professionals, as well as researchers, are given. Finally, conclusions are presented.

Meal composition

Few studies described in the literature focus on systematic meal composition methods. Buisson & Garel (2003) describe a software system based on mathematical models, for example, diabetes patients who can use the system to monitor their diet and nutritional balance of meals. Veiros *et al.* (2006) describe a method which aims at assisting the foodservice professional in preparing a menu that is nutritionally and sensorically more adequate than previous offerings. This evaluation is based on assessing existing menus regarding issues, such as availability of healthy components, colour combinations, cooking methods and fat content, over a 1-month period. Moskowitz (2001, p. 35) describes a system that '*identifies what the customer wants, and guides the foodservice professional to create a product that fulfils that desire*'. The system is based on '*systematised acquisition and deployment of relevant information*' (Moskowitz 2001, p. 35), using conjoint analysis to combine different elements of a product [in the given example, elements for a burger could be 'less fat than other burgers' or 'bun made with San Francisco Sourdough' (Moskowitz 2001, p. 42)]. The method focuses on product design at the concept level, but does not deal with the actual food itself (texture, aroma, appearance, etc.). On a more general level,

Moskowitz *et al.* (2006) describe a software program, which can generate new food and drink concepts, based on sensory data. The system uses combinations of different elements of concepts (so-called 'idealets'), which are tested at a consumer level. In relation to sensory interactions between components of a specific meal, very few investigations exist and they mainly focus on the interaction between wine and cheese. It is, for example, known that white wine decreases buttery and woollen flavour in one kind of cheese (Bredsjö), while saltiness and sour taste were decreased in another kind of cheese (Roquefort) (Nygren *et al.* 2003).

Buisson & Garel (2003) make meal design a question of interaction between consumer (the hospital patient) and the system, focusing exclusively on nutrition, although consumers buying products from the foodservice sector must be assumed to have a much broader quality focus. Moskowitz (2001) describes elements representing different alternatives for categories of product features, but keeps the analysis at a level of customer demand and end product features, not entering into the specific product design. Moskowitz *et al.* (2006) consider the idea of combining different idealets and presenting these to consumers for evaluation and concept development. They do not, however, consider specific products and optimisation of product component combinations regarding possible interactions, overall product performance and variation, which are also common challenges for the foodservice professional. The method described by Veiros *et al.* (2006) handles issues with a closer relation to the actual meal, but on the other hand, they lack the awareness of consumer demands, focusing too much on food products. Furthermore, their level of analysis is more general than the individual meal. The only aspect of sensorial quality included is appearance, and more specifically limited to colour combinations. Taste is not included in the evaluation, nor is the perception of the individual meal as such. Thus, the method only provides an indication of the nature of the components from which meals can be made, and not of the actual meals presented to consumers. The only research related to sensory interactions in meals is specific to wine and cheese (Nygren *et al.* 2003).

Thus, the meal composition methods described in the literature have a quality focus that is too narrow, or are at too high a conceptual level in relation to specific meal solutions. They do not present satisfactory solutions to the problem of how to develop products, not concepts, which consider several quality aspects, not just individual dimensions such as nutrition or sensory properties. Modularisation is an alternative with potential advantages in these areas that remain to be applied in relation to food products.

Modularisation

Modularisation is generally defined as ‘... *building a complex product or process from smaller subsystems that can be designed independently yet function together as a whole*’ (Baldwin & Clark 1997, p. 84). A basic element of modularisation is that modules, as well as interfaces between modules, are specified. The description of interfaces plays an important role because it facilitates interchangeability of modules (and hereby variation of end products) and ensures an optimal quality of the end product (Ericsson & Erixon 1999). Modularisation is becoming widespread as a response to general developments, such as the increasing rate of change, increasingly empowered consumers and increasing complexity of products (Sanderson & Uzumeri 1995; O’Grady 1999) – all challenges of relevance to the foodservice industry. Some of the advantages of modularisation mentioned in the literature are strategic flexibility, more consistent quality, reduction of product lead time, increased product variety, enabling of mass customisation (combining mass production of modules with customisation of end products to individual customers), boosted rate of innovation and increased reliability (Sanderson & Uzumeri 1995; Baldwin & Clark 1997; Ericsson & Erixon 1999; O’Grady 1999; Muffatto & Roveda 2000). Some of the major considerations are that modularisation can be costly if commonality (i.e. using the same meal components in several different meal solutions) across products is low, and that partition between modules must be precise, unambiguous and complete for it to work (Ulrich 1995; Baldwin & Clark 1997).

On the basis of the advantages and considerations described, modularisation of meal solutions seems to be a relevant issue to explore further. Because of the many different consumer segments (which are catering to children, elderly, hospital patients, working people on-the-go, canteens, etc.), variation, flexibility and customisation are highly desirable, as well as the ability to be innovative and quality oriented. At the same time, commonality across products must be optimised to create an economic advantage as well as reducing waste, because products often have a short shelf life, and a high component turn-over is optimal. Partitioning between modules lies in the nature of the supply of components to meal solutions, as it is typical for different suppliers to provide separate parts of the finished meal solution (such as meat, spices, condiments and vegetables). This supply situation is based on a tradition for food producers to keep within a specific sector. In the Danish food industry, for example, this is partially caused by the roots of many food producers in the cooperative movement, where, for example, slaughterhouses are owned by the pig producers who supply the raw materials (Søgaard 1994).

Although meal solutions can appear to be less complex than typically modularised products such as computers, electronic products, etc., they possess multiple inherent complexities, as module interchangeability, for example, is actually much higher. A car door, for instance, has given dimensions and interfaces with several connecting modules, which place constraints on the design possibilities for that specific component. A module in a meal solution, on the other hand, is dependent on general considerations about *interactions* (rather than mechanical *interfaces*) between module types and processing conditions, but there are almost infinite possibilities for raw material choice in relation to the specific module. Thus, although meal solutions consist of considerably fewer modules than computers or automobiles, the variation within the modules in the overall product structure forms the basis for a plethora of possible end products, which is similar to, or even higher than, that of seemingly more complex products. It is therefore relevant to explore the possibilities of a modularisation approach that is suitable in relation to meal solu-

tions. In this context, we define meal modularisation as *composing a meal solution from several components, based on end-user requirements, integrating functionality of individual components, processing conditions as well as potential component interactions*.

The Meal Composition Approach

The MCA presented here builds on a broad range of modularisation literature, which describes principles of translating consumer requirements of the end product into product functions and further into module specifications, considering module interfaces, assembly restrictions, etc. (Ulrich 1995; Jiao & Tseng 1999). It is inspired by the 'Module Identification Approach' (O'Grady 1999, pp. 157–68), a practice-oriented method. The MCA consists of seven steps, which can be thought of as a framework for the foodservice professional. The systematic approach embraces both general as well as meal-specific considerations. A critical aspect of modularising meal solutions, as opposed to typically modularised industry products such as automobiles, computers, etc., is that the modules are assembled into a version of the product, which will be further prepared and/or stored, and thus changed, before it is consumed. Furthermore, components and meal solutions are typically perishable, as they are biological products that interact and change continuously. Thus, considerations of possible interactions during handling and processing

play a focal role in the modularisation of meal solutions. Issues, such as shelf life of the whole meal, potential unintended interactions regarding, for example, taste and hygiene, as well as reheating procedures, etc., have to be kept in mind, affecting specifications of modules as well as processing.

The MCA is based on relevant food-related research including a specific example from a study of sensory interactions between different meal components. The method is exemplified in relation to on-site foodservice cook-chill production methods, to illustrate the potential benefits in a widely known context.

Applying the method – guidelines and examples

The MCA will be described here in detail. The first section in each step provides general guidelines, which are then explained in further detail. Furthermore, a running example (boxed text) will be given for relevant steps, concentrating on avoiding warmed-over flavour (WOF) in meat, which is a relevant consumer requirement (Bryhni *et al.* 2003). Principles of the MCA are depicted in Fig. 1.

Step 1: Identifying product categories

In this step, the product categories (one or more), which the modularity programme will address, are identified. Products included in the main categories have common characteristics, similar

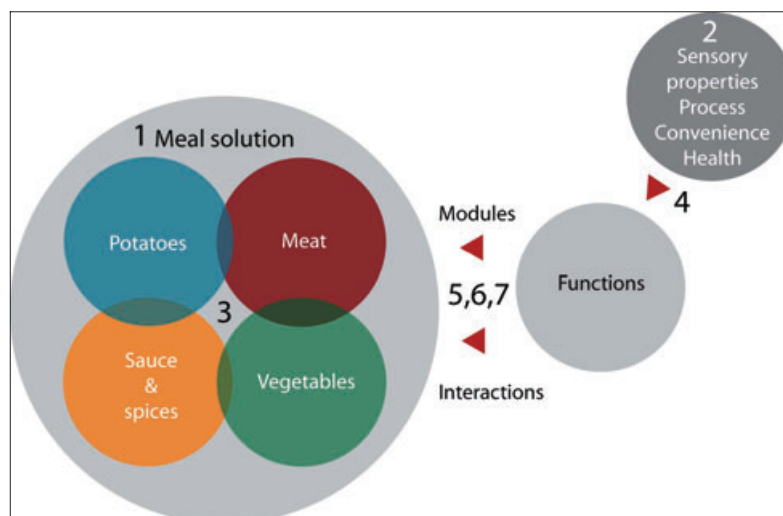


Figure 1 Principles of the meal composition approach. The numbers reflect the seven steps in the method.

properties, fulfil similar consumer needs, have common modules (if modules are identified at this stage), etc.

The overall product category of relevance to foodservice professionals is meal solutions. Meal solutions are defined as main courses or pre-assembled main course components of a meal, bought and/or consumed outside the home. This definition of meal solutions is in line with Costa *et al.* (2001), who state that meal solutions fulfil the needs of consumers who cannot or will not fully cook a main meal at home, and that meal solutions can be eaten out of home at a serving place (hotels, restaurants, catering or institutional kitchens) or in home (home meal replacements) (Costa *et al.* 2001, Fig. 1). In this paper, we focus on meal solutions served out of home, including sub-groups corresponding to foodservice segments such as catering in hospitals, for the elderly, in canteens, schools or on the go.

Example: The product category is hot meal solutions served out of home.

Step 2: Identifying potential consumer requirements and market opportunities

In this step, existing and potential consumer requirements are identified through marketing surveys, consumer complaints, evaluation of competing products, etc. Each consumer requirement is evaluated in relation to its importance for a specific consumer group, which the foodservice professional is dealing with.

Brunso *et al.* (2002) conclude, on the basis of numerous focus group studies, that consumers emphasise four major food quality dimensions: health, taste, convenience and process characteristics (such as organic farming, animal welfare, non-genetically modified organisms, etc.). Rappoport *et al.* (1993) also found support for three of the factors: health, taste and convenience. A possible explanation is that process characteristics were not found of importance, and that this is a relatively recent development in consumer awareness (Brunso *et al.* 2002). Specifically in relation to meal solutions, Costa *et al.* (2007) found that the replacement of home-

made meals by ready-made meals to a great extent is dependent on the perceived trade off between sensory/health-related benefits and convenience features. This underlines the importance of optimising all three quality factors simultaneously in the product development process. For example, Reisfelt *et al.* (2007) have recently analysed consumer preferences for meal composition and presentation, finding evidence that product appearance is important for consumer choice in relation to, for example, the size of meat slices and type of vegetables. Stevenson *et al.* (1995) found appearance and aroma to be more important than flavour and texture in a consumer assessment of chilled ready meals. On a more general note, Moskowitz & Krieger (1995) concluded that flavour, texture and then appearance were the most important aspects of sensory impressions to consumers. Thus, the consumer requirements, which are included in this study, are health, sensory properties, convenience and process characteristics. There is a consensus in the literature of the importance of sensory properties; at the same time, health and convenience are also considered critical, while process characteristics are considered to be less important, but they are receiving increasing awareness from consumers.

The four factors can be weighed differently and detailed further, depending on the target groups which the specific foodservice professional is dealing with. Examples of what consumers may stress within the groups in relation to foodservice outlets are given in Table 1.

Example: The focus is on the sensory properties of the meal, especially on how to avoid WOF of the meat module.

Step 3: Identifying overall product structure and processing conditions

In this step, the high-level product architecture will be determined; namely, what general module groups will the end product consist of and what potential module interactions should be taken into consideration. Furthermore, an overview of handling and processing conditions is given.

Table 1 Examples of sub-elements of the five major quality dimensions for consumers

Quality dimensions	Examples
Sensory properties	Avoid warmed-over flavour in meat (Bryhni <i>et al.</i> 2003) Avoid potato off-flavour (Petersen <i>et al.</i> 1999) Tenderness, fried flavour and juiciness of the meat (Aaslyng <i>et al.</i> 2007) Module combinations improving the impression of the final meal (Reisfelt <i>et al.</i> 2007)
Convenience	Ready to eat (Costa <i>et al.</i> 2001) Customisation (Scholderer & Grunert 2005)
Health	Nutritionally balanced meals (Nordic Council of Ministers 2004) Food safety (Grunert 2005)
Process characteristics	Organic production, no additives, animal welfare, non-genetically modified organism production (Brunsø <i>et al.</i> 2002)

Table 2 Overall product structure – modules and examples

Module	Examples
Meat	Loin, inside leg muscle
Potatoes	Potato, rice, pasta, bread
Vegetables	Cabbage, carrot, cucumber (pickled), salad
Sauces and spices	Meat-based gravy, mashed pumpkin, rosemary marinade, chilli, salt

Meal solutions are divided into modules as presented in Table 2, alongside examples. These modules have been chosen to represent a meal in a conventional Danish diet, where nutritional recommendations typically include meat, potatoes (or another source of carbohydrates) and vegetables (Danish Food and Drug Administration 2007). Condiments and spices have been included, as they contribute to further sensory properties of the meal, which are important for the meal composition. In this step, processing conditions will also be determined, corresponding to the actual conditions under which the individual foodservice professional operates. Factors included are storage conditions and time, assembly procedures, processing equipment, reheating procedures, etc. Interactions between all modules are of relevance as they influence, for example, sensory properties of the whole meal and possibly health aspects (food safety), during storage and at the point of consumption, especially if the meal is assembled in a one-compartment container. For example, packaging in modified atmosphere can

be beneficial in relation to the meat component, but the effect on the other modules must also be considered.

Example: The meal consists of meat, potatoes, vegetables and either spices or sauce. It is presumed that the first heat treatment of the meat is performed prior to component storage, meal assembly (in a multi-compartment tray) and packaging. The meal will be reheated prior to serving.

Step 4 Mapping consumer requirements to functions

For each of the consumer requirements, potential end product functions that match the specific requirement are identified. The more well defined and concrete the consumer requirements, the easier it will be to map these to product functions. It will also be appropriate in some cases to map requirements to functions related to processing and handling issues.

To match the identified consumer requirements with product-related knowledge, which the foodservice professional can apply in relation to the composition of meals, ordering of supplies, etc., specific corresponding functions have to be identified. Such functions will reflect the characteristics of modules, end product and handling of these, which support the aim of fulfilling consumer requirements. For *sensory properties*, the requirement of an attractive appearance may

adhere to the way the modules are presented in the final meal solution; the way vegetables and meat are cut, if the sauce is on the side, etc. A study in Denmark showed that consumers prefer a meal where the meat is cut in small cubes, compared with whole steaks, when judging by the appearance (Reisfelt *et al.* 2007). When mapping the consumer requirement *convenience* to functions, issues such as the degree of preparation of modules prior to reheating and functionality in the serving situation (for example, what must be fulfilled to consume a meal on the go) must be considered. The nutritional requirements related to *health* can be mapped directly to functions, while issues such as food safety have to be translated to more specific processes and product characteristics (for example, an end core temperature for meat of 75°C). The consumer requirement, *process characteristics*, can be mapped to functions almost directly as well – for organic production, the function of all modules is that they must conform to organic standards, etc. For each of these functions, a more detailed information has to be considered, as in the example below, where eight sub-functions support the function of avoiding WOF in meat (Tørngren 2006). Several of these sub-functions include processing and other handling characteristics related to one or several modules.

Example: Avoiding WOF is an important sensory property of meat. WOF develops after heat treatment due to oxidation of lipids, especially phospholipids. This oxidation is accelerated compared with non-heat-treated meat as the membrane structure is altered during the heating (Straadt *et al.* 2007), combined with an increased content of free iron as the myoglobin is denatured above 65°C (Hunt *et al.* 1999). The main functions, which the requirement 'avoiding WOF' can be mapped to, are therefore avoiding or decreasing oxidation. These functions can be divided into sub-functions, which consider aspects of module combinations as well as processing and handling.

- First, development of WOF in the meat can be reduced by *choosing meat with a low*

pigment content (myoglobin), as it has been shown that light muscles, such as loin, develop less WOF than redder muscles such as inside leg muscle.

- Another way of reducing the development of WOF is *marinating the meat*. A neutral sodium brine and a brine containing antioxidants have been shown to effectively reduce WOF, but it is also possible to marinate with natural antioxidants such as in fruits, juice, tea and green spices.
- The *core temperature during the first heat treatment* is important for the development of WOF. Keeping the core temperature at a maximum of 65°C reduces the development of WOF during storage.
- Using a *gentle heat treatment* like an oven temperature of 95°C furthermore reduces the WOF.
- The size of the meat must be harmonised with the other modules to ensure a *homogenous reheating size*.
- From the cooking of the meat until reheating, the meal is sometimes stored for several days. The shorter the period, the better in respect to WOF. After 2 days, the maximum WOF level has been reached, and a *shorter storage time* is therefore preferred.
- Decreased access to oxygen decreases WOF. *Packaging in modified atmosphere* free of oxygen is a possibility.
- Another possibility of decreasing the oxygen exposure is by *covering the meat* with sauce, (mashed) potatoes or vegetables such as onions or pumpkin.

(Tørngren 2006)

Step 5: Mapping functions to potential modules and uncovering potential interactions

Here, functions are mapped to the modules involved, establishing an overview of potential interactions between modules. A matrix system or similar is used to facilitate selection and the following consolidation in step 6; see Table 3.

The functions will, in some cases, be related specifically to one of the major modules, as for example the size and form of vegetables. They can

Table 3 Example – mapping functions to modules

Functions	Modules			
	Meat	Vegetable	Potato	Sauce or spices
Choose meat with low pigment content	x			
Marinate the meat, for example, with green spices	x			x
Keep core temperature of meat during first heat treatment below 65°C	x			
Use gentle heat treatment of meat (for example, oven temperature of 95°C)	x			
Harmonise cut size of modules	x	x	x	
Short storage time	x	x	x	x
Package in modified atmosphere	x	x	x	x
Cover meat with sauce/vegetables	x	x		x

also relate to several modules simultaneously. An example is fulfilling the maximum requirement of 30% energy from fat, which is based on an evaluation of the fat content in all modules. Finally, functions can relate to module interactions, such as the reduction of bitter taste in pork meat patties by serving a salted or sweet vegetable side dish (Aaslyng & Frøst 2007).

Step 6: Consolidating and refining modules

In this step, modules are consolidated and refined to optimise quality, reduce costs and raise future profitability, while still meeting consumer requirements in a prioritised order.

Consolidation and refinement of modules can be relevant if functions are overlapping several modules (as in the fat content example discussed previously) or if optimisation of the final meal in relation to specific consumer requirements is dependent on module combinations and interactions (as in the example of reduction of bitter taste discussed previously, where meat and salted vegetable side dish could be an example of a consolidated module). This has to be evaluated by the individual foodservice professional in relation to their specific target groups, consumer requirements, choice of raw materials, etc. An example of refinement of modules could be alignment of reheating time through adjustment of cut size for the modules, to avoid, for example, overcooking of vegetables because the meat is cut in too-large

pieces. Another consideration could be an assurance of all modules living up to a shelf life specification for the meal solution as such.

Example: In the process of mapping functions to modules, it becomes obvious that some modules can be consolidated, for example, meat and spices, in which it is marinated, and/or meat and vegetables, in which it is covered. Modules can also be refined, for example, by harmonising cut size.

Step 7: Identifying module characteristics and suppliers

In this final step, various elements of the modules, including possible combinations with other modules, quality levels, etc., are identified. The module supplier also has to be selected at this stage, and specifications, including handling and processing issues, are prepared.

As a rule of thumb, to achieve nutritional requirements, the hot main meal should consist of 20% meat, 40% carbohydrate and 40% vegetables (Danish Food and Drug Administration 2007). These module characteristics are important to keep in mind in combination with the information obtained in steps 5 and 6. Suppliers will typically provide one of the major modules, placing a responsibility on the foodser-

vice professional to perform the consolidation of modules in practice to some degree and translating experiences from that into supplier specifications, for example, in relation to the resulting fat content of the whole meal.

Example: Module characteristics for the meat module: comprise 20% of meal, low pigment level, marinate with rosemary prior to processing, process at low temperatures to a core temperature of 65°C maximum, cool to a core temperature of 4°C, store for a maximum of 18 h at 4°C before assembly, harmonise cut size with other modules, cover in mashed pumpkin, package in modified atmosphere and reheat at 190°C until a core temperature of 80°C is reached.

Experiments have shown that the reheating method and core temperature are of less importance for the development of WOF compared with the handling of meat until the reheating step (M. A. Tørngren, in preparation), and this has to be reflected in the specification given to the meat supplier, especially if the supplier is delivering a product, which has already undergone the first heat treatment.

Implications

The MCA presented here can be used at several levels by foodservice professionals. The seven steps can serve as a framework to approach meal composition and consumer satisfaction in a systematic manner. By using the MCA, the foodservice professional can be guided through important considerations of identifying crucial consumer requirements and how these are translated into meals. Through further research, a tool to assist in this process is also conceivable, for example, through building a database of relevant information from researchers and suppliers. The foodservice professional would thus be able to supplement the database with their own experiences about interactions, modules, processing, etc., and use the MCA to support daily activities such as menu planning. The MCA can also provide inspiration to a dialogue between the foodservice professional and suppliers, giving

input to a more holistic approach and cooperation in new product development.

Within the MCA framework, foodservice professionals also have to handle dilemmas, especially in relation to prioritising consumer requirements. As an example, Dransfield *et al.* (2005) examined consumer attitudes towards the appearance and taste of pork with and without available information about whether animals were kept indoors or outside. Results showed that although consumers did not notice any taste differences, meat labelled with 'home produced' or 'outdoor' were preferred, and consumers were prepared to pay a premium. This illustrates how the foodservice professional can meet consumer requirements of both process characteristics and sensory properties by choosing pork from animals raised outdoors. In a more unfortunate situation, a prioritisation between the two consumer requirements has to be made. Specifically for organic pork, Scholderer *et al.* (2004) showed that expectations of organic meat prior to consumption were not met regarding the sensory properties after consumption. If sensory properties are more important to the foodservice professional's target group than process characteristics, consideration should then be given to choosing another type of meat. Another potential dilemma is related to the WOF example presented in this paper. If choosing to reduce WOF by marinating the meat in a neutral sodium brine, the foodservice professional has to consider the potential effect on the salt content of the total diet of the end-user – especially if they are catering for hospital patients or other groups with special dietary needs.

Other aspects that will also influence the outcome of the meal composition process are not directly related to the consumer requirements discussed here – these can be aspects such as legislation and price. Processing conditions for optimising quality can be limited by legislation, demands of, for example, a core temperature of prepared meat, to avoid microbiological hazards, which is higher than what is optimal in relation to sensory properties. Regulations related to different types of packaging systems, etc., also have to be taken into consideration. Price is, of course, also a decisive factor for consumers when choosing whether or not to actually buy a product, no matter how well it fits with the quality-oriented

consumer requirements. A potential dilemma for the foodservice professional in this respect is that although WOF can be reduced by choosing meat with a low content of pigment, this might not always be possible as there is also a need for using cheaper raw materials.

Conclusions and further research

This research fills a gap in the literature, combining meal composition, which has not previously considered potential interactions between components, potentially affecting the total quality of the meal, with modularisation, which has not previously been applied to food products. A new approach for foodservice professionals is introduced – the MCA – which offers a sequence of steps framing a systematic and holistic way of working with the quality of specific meal solutions, based on modularisation principles. The MCA uses consumer requirements as the starting point, and maps these to the functions of the final meal as well as the specific requirements of the meal components. Processing conditions and further handling of the food products are also included as important aspects to consider when building quality for the end-user into the meal composition and production. A running example of avoiding WOF in meat is used to illustrate the application of the method. By using this tool, foodservice professionals can thus match consumer requirements better, and at the same time, be able to place more precise demands on suppliers, because the characteristics of each component in relation to the production process and specific consumer group are specified in detail. In a long-term perspective, the tool can be used at a more detailed level, where information about potential modules, functions and interactions, as well as consumer requirements, can be gathered in a database, which can assist an even more refined and holistic way of handling meal composition in the foodservice industry. It will also be of great interest to develop and test the MCA under a wide range of different production conditions, such as production location (on-site/satellite/factory), production system (cook-chill, cook-hold, etc.), packaging method and size, reheating method, as well as cooking styles of components. The effects of focusing on supplementary quality

aspects, apart from sensory properties and nutrition, should also be considered. The MCA thus offers both short-term and long-term advantages as a relevant alternative to the existing methods of meal composition.

Glossary of terms

- *Foodservice professional*: individual responsible for meal composition in relation to a production unit producing meals for out-of-home consumption
- *Meal Composition Approach (MCA)*: seven-step method for meal composition based on modularisation principles
- *Meal modularisation*: composing a meal solution from several components, based on end-user requirements, integrating functionality of individual components as well as processing conditions and potential component interactions
- *Meal solution*: main courses or pre-assembled main course components of a meal bought and/or consumed out of home
- *Modularisation*: building a complex product or process from smaller subsystems that can be designed independently yet function together as a whole
- *Warmed-over flavour (WOF)*: Oxidation flavour developed during storage of heated meat

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4.4 Perspectives of meal modularisation

Paper C is aimed at food service professionals but considered in a broader perspective, embracing the food producers' point of view, meal modularisation also offers the advantage of making the actors capable of responding more accurately to consumer needs through meal composition guidelines and module specifications. This is illustrated within the framework of the quality cycle in Figure 4.1.

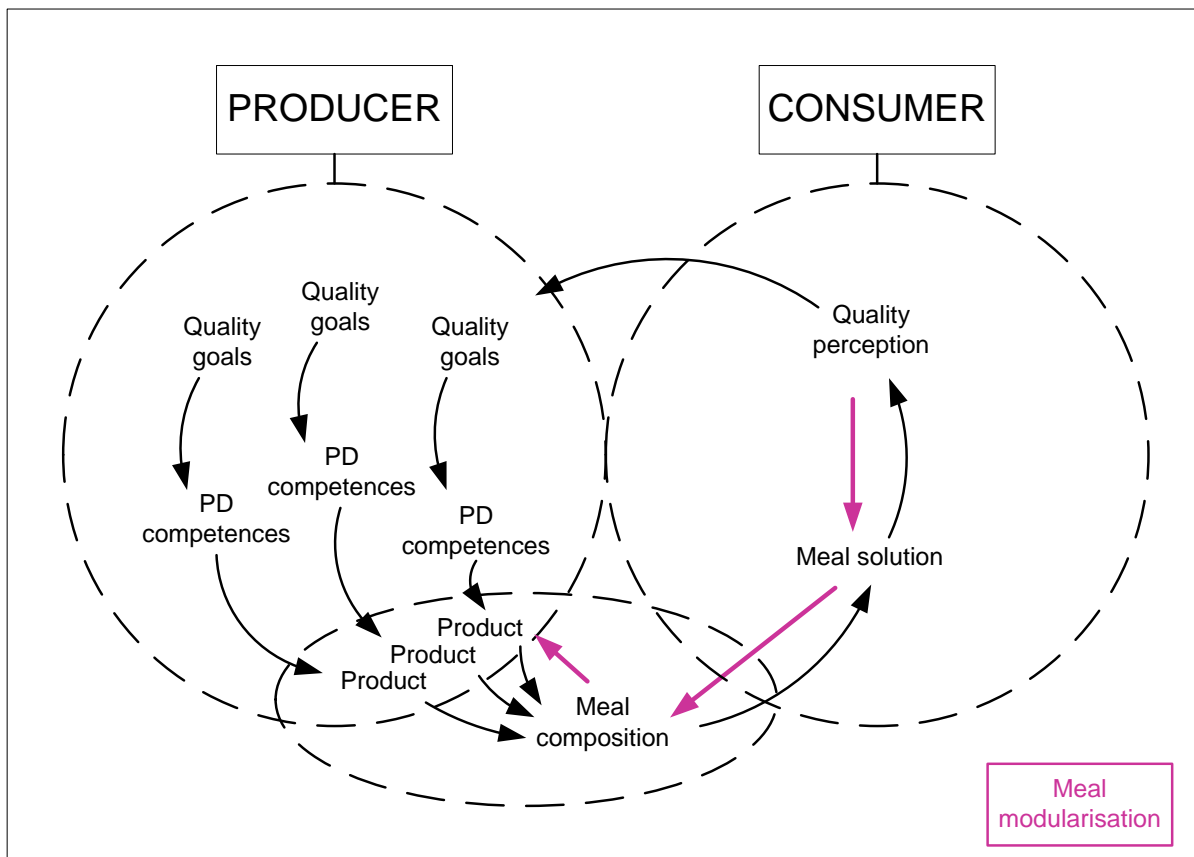


Figure 4.1. Meal modularisation as a mediator in the quality cycle. PD: product development

The meal composition approach (MCA) described in paper C is discussed in connection with the presentation of a very detailed example, and we may expect that for the MCA to cater duly for all consumer demands (not just one dimension) it should be backed by a database of module information. However, meal modularisation, and more specifically the MCA, does not necessarily have to offer a high degree of detail to contribute to quality improvements by mediating in the quality cycle. It may suffice to support discussions related to product development at a more general level, depending on the users' wishes and re-

sources. The most important feature of the MCA is its systematic nature, which ensures that meal composition is based on relevant considerations in relation to meal solution quality.

4.4.1 Mass customisation of meal solutions

Apart from responding to *specific* demands, *varying* demands can also be taken into consideration, which will ensure the fulfilling of more end users' needs. If commonality across meal solutions is high (i.e. modules can be used in several end products), producers can benefit from the advantages of mass customization, combining economies of scale with customisation to varying consumer needs (Pine et al., 1995). Figure 4.2 illustrates the potential benefits of applying both meal modularisation and what will subsequently be termed meal customisation¹³.

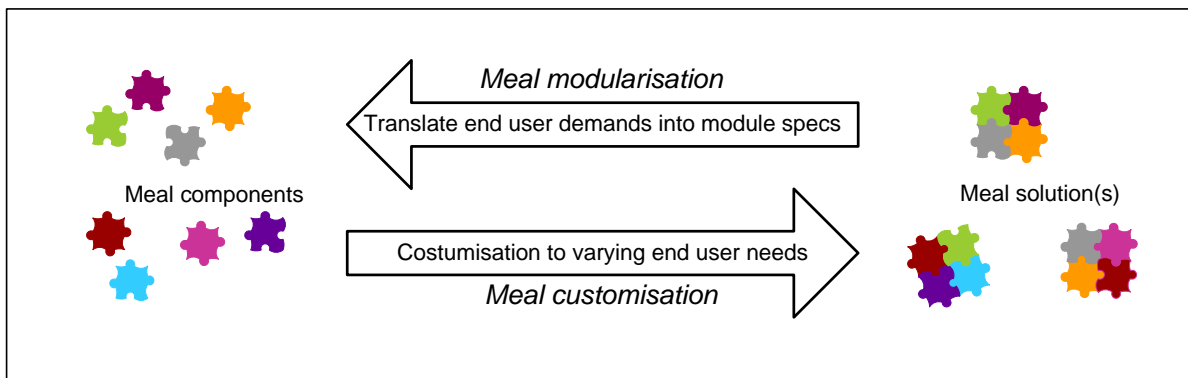


Figure 4.2. Possibilities offered to the producer by applying meal modularisation and meal customization.

Boland (2006) discusses the applicability of mass customisation in the food industry, finding that it already exists to some degree in the food service sector, where e.g. pizzas, burgers and sandwiches are customised. However, the author points out that in these cases, customers are not directly involved in the product development as such, but rather offered a range of choices when buying the product. This corresponds to what Gilmore & Pine (1997) term adaptive customisation, where customers are offered standard, but customisable products, which they can alter themselves. Combined with modularisation, it seems

¹³ Meal customisation is understood as the customisation of meal solutions to a wide range of end-user needs by combining efficiently produced components.

possible that mass customised food products can better fulfil consumers' needs when product knowledge is used actively in the product development process. Furthermore, nutritional, sensorial and other requirements of the whole meal can be taken better into consideration by restricting possible module combinations.

4.4.2 Module groups – a preface to modularisation

To obtain a high degree of commonality in meal modules, supporting meal modularisation and customisation, it may be advantageous to work with module grouping. These module groups could be composed on the basis of their characteristics and robustness vis-à-vis further processing to ensure that component and meal specifications are met within a given “quality window” at the point of consumption. Working with module groups will assist the producer in avoiding undesired quality of meal solutions, e.g. by way of over-treatment of highly water-containing vegetables reheated with large cuts of meat. Module groups can be defined in relation to the remaining preparation of the meal – e.g. ready to-eat, ready-to-heat, ready-to cook, ready-to-prepare or ready to compose. Furthermore, it is also important to take into consideration the preparation stage of the component at the stage of assembly; viz. is the component raw, sliced, pre-cooked or fully cooked. Other important module characteristics such as nutritional and sensory profiles, appearances, etc., also have to be considered when composing a well-balanced and inviting meal. Working with module groups could be part of a preparatory activity in the modularisation process and should in that case address three points: 1) down-stream process conditions for the meal solution should be determined; 2) suitable module groups should be identified; 3) modularisation should be performed on the basis of these groups, using consumer demands as a starting point.

4.5 Conclusions and implications

The present chapter illustrates the potential of modularisation in relation to development of meal solutions. The basic idea is to let product development be guided by consumers' requirements to the end product and then specify its constituents as well as the related processes. Today, the production of product modules is ‘tunnel-like’ in the sense that it is guided more by tradition and industry structure than by consideration for meal solution quality. Meal modularisation offers an approach to retain focus on core products and com-

petences as well as the meal solution. The meal composition approach has been introduced as an example of how to execute meal modularisation. Furthermore, there is much potential in supplementing the Meal Composition Approach with meal customisation.

Meal modularisation can be performed, as suggested in paper C, by a food service professional or other actors in a vertical chain taking on the role of meal composers, using food producers merely as module suppliers. There is an important strength in adopting meal modularisation in cooperation between food producers – in a meal development alliance. The rationale is that tacit module knowledge predominates in the food industry. In e.g. the automobile industry, modularisation is performed by a focal company, which draws on its product knowledge when specifying what they need from the suppliers. In contrast to this, product and process knowledge is more integrated with individual module producers within the food sector, presumably because modules or raw materials have traditionally been sold individually to consumers or food service professionals, who have the final responsibility for meal composition. Knowledge about modules and their possibilities and requirements for optimal use and preservation of these modules therefore rests with individual food processing companies and is not necessarily available for potential meal composers. Chapter 5 discusses this aspect and other potential synergy effects of combining meal development alliances and meal modularisation.

To reap the potential benefits of modularisation discussed above, managers should first and foremost be aware of the importance of having the meal solution – not its components – as the point of departure in product development (as with meal development alliances), and, secondly, that managers should ensure that consumers' demands are translated into relevant module specifications. Furthermore, product and process knowledge has to be used actively. Producers may also find it helpful in their transition to a modularisation mode of food development to rethink the relevant parts of their product portfolio in terms of module groups and to consider the interchangeability of these modules.

Further research should focus on exemplifying the applicability of meal modularisation and on building further knowledge on module interactions, getting nearer to defining a dominant design for meal solutions.

5 MATCHING CONSUMER DEMANDS AND MEAL SOLUTIONS

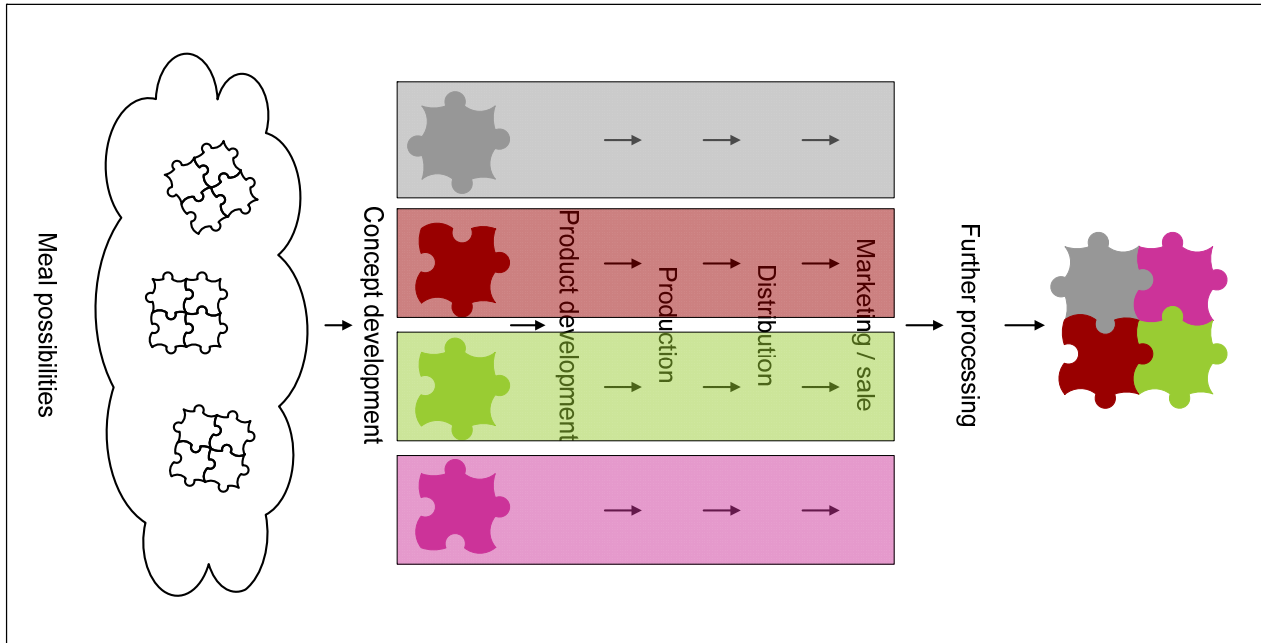
In this concluding chapter, the possible synergy effects of combining meal modularisation and meal development alliances are discussed and guidelines for their use in practice are presented. Furthermore, the feasibility of the research results is considered. Finally, the research approach will be evaluated. The main research question posed in this chapter is

RQD: What are the effects on meal solution quality of combining modularisation and product development alliances?

5.1 A new approach to development of meal solutions

A recent survey in the Danish food industry indicates that innovation activity is increasing - more products are being introduced on the market, even if a majority of these are adjustments to existing products or “me-too products” (Baker, 2007). To protect their competitive advantage, food producer have to differentiate themselves from their competition, e.g. through less imitable products. Producers usually build up individual strengths and base their profits on the products they actually produce and sell. However, solely adopting a meal component based approach can have unwanted consequences in a market where consumers are looking for whole meal solutions. Food producers should be open to considerations of how meal components interact to constitute the end product that is presented to the consumer, and *then* turn inwards to issues related specifically to their own business and core competences. Such an approach is illustrated in Figure 5.1. Instead of starting their product development by focusing on their own component (as e.g. illustrated in Figure 1.1), they should consider meal possibilities together and develop an over-all meal solution concept on the basis of which components can then be developed combined. Thus, downstream processes can still be performed individually. This approach will restrict alliance activities to areas where they can really make a difference quality-wise, and reduce barriers to entering such arrangements because unnecessary reorganisation related to e.g. sale can be avoided. This offers them the possibility of realising a higher end product value and quality, which, in turn, can support their own competitive advantage. In an industry that is traditionally very good at process optimisations and efficiency, but lacks radical product innovations, there is a promising potential in committing some of

the product development efforts to a more complex (and less imitable) product further down the value chain – such as a meal solutions composed of several components.



Figur 5.1 A new approach to meal solution development.

5.2 Synergy effects of meal development alliances and meal modularisation

The market for meal solutions has presented itself as an interesting area for food producers for introduction of new products. As consumers are increasingly being exposed to meal solutions in different situations and from different sales channels, they are becoming more focused on quality and they expect variation. The main research proposition was that product development alliances between food producers, supported by modularisation, could facilitate quality improvements of meal solutions (as perceived by the consumer). This research has previously shown that main features of meal development alliances are the alignment of quality goals between participants, ensuring relevance of product development competences as well the exploitation of knowledge about meal components, processes and potential interactions in the meal solution. In this way, producers can potentially better fulfil consumers' demands for varied, high-quality meal solutions. Furthermore, meal modularisation has shown its potential as a practice-oriented tool facilitating the translation of consumer demands into meal composition guidelines and meal component specifica-

tions. Thus, modularisation supports a consumer oriented approach and an operationalisation of the quality goals set up for the meal solution.

It is reasonable to assume that combining these two approaches will produce synergy effects because the discussion/consensus approach in meal development alliances will be supplemented well by the more hands-on approach of meal modularisation. Figure 5.2 illustrates the combined mediating effects of meal development and meal modularisation in the quality cycle. Both meal modularisation and meal development alliances link the product and the orientation levels (goals and perceptions) of the figure, and they enhance the producer's ability to engage in the development of product components of a relevant quality in the meal solution context.

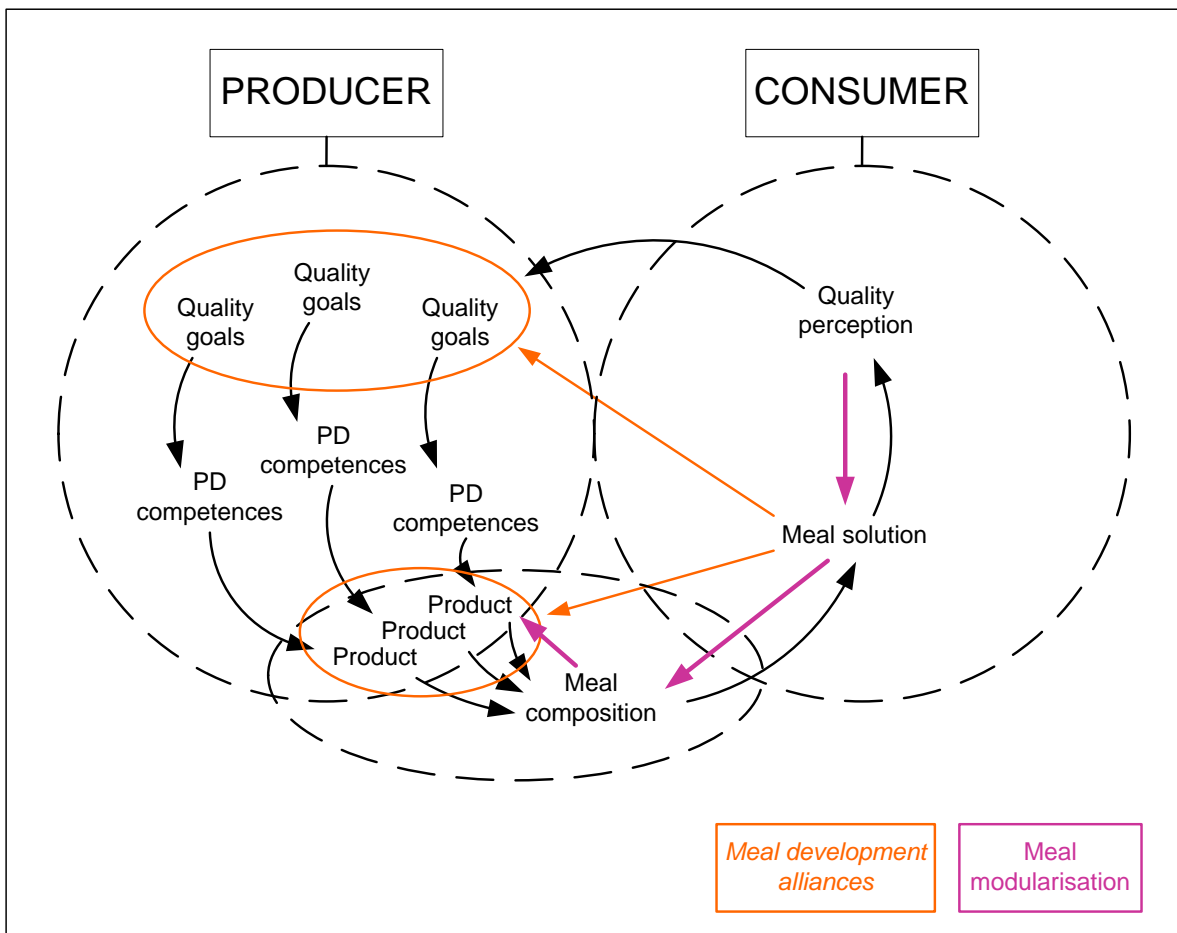


Figure 5.2. Meal development alliances and meal modularisation as mediators in the quality cycle.
PD: product development

In meal development alliances, quality can be improved by drawing on producers' knowledge of products, processes and interactions in the product development phase and by working towards a common goal. Meal modularisation structures product development, supports a common frame of reference and integrates an orientation towards consumer demands by making them operational. Thus, the two approaches support each other by both translating consumer quality perceptions and demands into specifications for the meal solution and its components and by ensuring that these demands are in line with the quality goals managers use to guide product development and the resulting products.

Figure 5.3 illustrates the main benefits of meal development alliances as well as the concrete points on which it is supported by modularisation.



Figure 5.3. Main benefits and supporting effects (in bold) of meal development alliances and meal modularisation

A main effect of combining the two approaches is an increased ability to mass customise. The advantages offered by meal modularisation are more easily exploited within the frame of meal development alliances because of the longitudinal dimension of cooperation be-

tween the suppliers. Additional potential is obtained by claiming responsibility for meal development and / or composition, because this role is not yet “owned” by anyone. Meal modularisation is not necessarily bound to a focal supplier with meal composition responsibility and a group of sub-suppliers as in the traditional modularisation industries. Meal composition could take place at any place in the vertical chain – it could be the consumer, a food service professional, a focal supplier, but it could also be claimed by a meal development alliance, offering the alliance the opportunity of control of quality goal fulfilment and the possibility of mass customisation.

5.3 Implementation perspectives

The results from the questionnaire survey among Danish food producers offer interesting perspectives on the usability of the research presented in this dissertation. Very strong agreement was found in at least three important areas:

- Meal solutions will gain larger market shares in the future and the focus on quality, convenience and health will grow stronger
- One of the primary benefits of product development alliances is the enhanced ability to meet new market demands
- It is important to set goals for the quality of the meal solution at the point of consumption and to be able to customise the meal solution to different consumer segments.

The main theme of the present thesis, viz. the connection between meal solution quality, meal modularisation and meal development alliances, is accordingly intuitively recognized by food producers as the key to potential implementation. Reactions from Danish food producers to recent presentations of the research confirm this observation (Danish Agricultural Council, 2008b). However, there is a lack of current examples of functioning meal development alliances and application of modularisation principles. To aid this implementation, managerial guidelines have been developed to help companies get started, taking into account the research results, i.e. factors for initiation and success of product development alliances relevance of quality goals and product development competences as well as the Meal Composition Approach. These guidelines are presented in the following.

5.3.1 Managerial guidelines

The below section offers managerial guidelines for meal modularisation in meal development alliances aimed at improving quality. The six phases describe how managers can approach an implementation of meal development alliances and support this process by meal modularisation.

1. Identify market need and partners

To establish a meal development alliance, the presence of a relevant market need for meal solutions that cannot be satisfactorily met by an individual company is required. Furthermore, a match of partners with relevant competences is required. There are several possible ways of initiating an alliance, depending on whether partners e.g. know each other beforehand and identify a market need in a common forum or whether one partner assumes responsibility for establishing the alliance.

2. Discuss mutual expectations and set goals for the alliance

Partners have to agree on entering into product development together, to discuss their mutual expectations and to set up an organisational and operational structure for the alliance. Thus, the results achieved can be evaluated in light of the initial, formulated goals, and future cooperation, resources and responsibility can be allocated correctly and misunderstandings and other problems hopefully be avoided.

3. Set relevant quality goals for the meal solution and its components

Quality goals for the meal solution have to be well-considered, as the product development (and modularisation) process ideally depends on the goals on which it is based. Quality goals can be objective and measurable, but the strength of working with modularisation is its ability to translate also tacit and subjective quality demands into operational product requirements. The ability to set relevant quality goals thus depends on the knowledge about end-user demands, which can be generated from direct interaction between producers, users and/or consumers, as well as from market research, etc. Furthermore, it is important that each partner makes sure that quality goals for the meal solution are aligned with the quality goals for the components.

4. Apply modularisation to specify modules

When the alliance has been established and organised successfully and well-founded goals set for the outcome, the work of translating quality goals for the meal solution into concrete module specifications - meal modularisation by way of the Meal Composition Approach - can begin. Modularisation can be performed at several levels depending on the sum and form of product knowledge available. To apply information, it has to be retrievable, which means that the larger the amount of data, the more important it is to systematise it and make it operational. As mentioned, working with module groups is highly relevant and it will be advantageous for the partners to create a common overview of the possibilities in this respect for different processing conditions (and thereby situations of use), in relation to e.g. production systems in large scale kitchens.

5. Make conscious choices regarding product development competences when specifying and developing modules

Managerial choices of product development competences should correspond to the chosen quality goals for the product, which, in turn, should be in accordance with end user quality perceptions. This is of importance both in the process of specifying modules and interfaces, as well as when actually developing modules that comply with these specifications.

6. Facilitate variation / mass customization by using knowledge actively to define module groups and interactions

Modularisation unfolds its potential best when used on product series, and not just individual products. One of the great advantages of this approach is mass customization, combining mass production principles (economies of scale) with customization to segment-wise end-user needs. The more detailed and operational the knowledge available, the better possibilities are for making mass customization work. Two important ways of supporting this process are 1) to collect knowledge about modules and interactions in e.g. a database and 2) to compile modules in groups based on common characteristics with regards to e.g. the optimal method (e.g. defined by time and temperature) of further processing.

The presented guidelines can support the implementation of meal development alliances and meal modularisation at several levels. Section 5.3 discusses the likelihood that a development towards applying these approaches will take place.

5.3 Feasibility of implementation

A realistic scenario exists for food producers to enter into meal development alliances supported by meal modularisation with higher quality and variation of meal solutions as results. The feasibility of this course of action, however, depends on two things: 1) the demand for high quality and varied meal solutions, and 2) the degree of creative involvement (restricted by time and / or ambitions) in meal composition from the actors assembling the product (if external to the alliance, e.g. the consumer or an intermediary) – i.e. how much of the meal composition is it possible for the producer to influence. The results of the present thesis are deemed to be very relevant to food producers in the light of current developments which witness a growing diversity of sales channels and a continuing increase in the demand for meal solutions of high quality and variation; developments that are matched by a decreasing involvement in composition from consumers and / or intermediaries such as food service restaurants. The relevance will be particularly evident if producers devote efforts to obtaining an optimal starting point for each product development case by identifying the relevant consumer quality requirements.

So does meal development alliances and meal modularisation represent a solution to companies seeking a quality focus and satisfaction of future consumer demands for meal solutions? The research results reveal a promising potential for implementation and integration of these two approaches. The real benefit for food producers lies in the wide span of metaforms of meal development alliances and meal modularisation that can support a company's competitive position. It would therefore seem realistic to expect an emergent use of meal development alliances and meal modularisation in the food industry.

Papers B & C separately described the possibility of implementing the two approaches and discussed how each may take on different forms. The ability to set goals for meal solution quality and fulfil these goals relies heavily on knowledge about consumers, product and processes. In this dissertation it has been suggested that companies protect their core

competences and competitive position by applying their knowledge directly in meal development alliances, but in some cases it will also be possible to obtain the relevant knowledge from different external actors, combining the meal development alliance with other types of product development alliances, for which there is a stronger tradition in the food industry. In the case of modularisation, it is also possible to apply the principles in a variety of ways from conceptual discussions to consulting comprehensive databases.

5.4 Revisiting the working hypothesis and research contribution

Returning to the working hypothesis: “quality of meal solutions can be improved by food producers entering product development alliances supported by modularisation”, some of the main aspects of the presented research are:

- Quality is a multifaceted concept. It is therefore important to be aware that quality improvement from the food producer’s point-of-view consists of two parts
 - Being aware of relevant consumer demands
 - Being able to meet these demands by improving relevant product characteristics

Based on this research, it is concluded that producers can support these point by aligning their own quality goals with consumers’ demands and by applying the appropriate product development competences.

- The concepts of product development alliances and modularisation have been sharpened to better fit the meal solution context. The research has shown that both approaches enjoy the potential of supporting quality improvements individually and that there can be substantial synergy effects of e.g. mass customisation when they are combined.

Thus, the working hypothesis can be confirmed.

The original goal was “to contribute to the knowledge base on product development in the food industry, mainly regarding quality, product development alliances and modularisation”. This goal is also deemed to have been reached. The present research has confirmed previous findings, and it fills several gaps in the literature within the mentioned fields. The four points on which the research was expected to contribute, see Section 1.6, have been further supplemented, resulting in the list presented below of major contribution points:

- Linking quality goals and product development competencies
- Applying modularisation in the food industry
- Developing a framework for product development alliances in the food industry
- Linking modularisation, product development alliances and food quality
- Developing a typology for product development alliances
- Introducing and applying the quality cycle
- Introducing new concepts to facilitate more precise communication within the field of research.

On a more general note, the present research supports previous recommendations from the literature, stressing the need for food producing companies to be more oriented towards consumer needs and quality perceptions and further suggests strategic and operational steps taken to meet these.

5.5 Concluding remarks

Coming to an end of a long journey, it is appropriate to consider whether the chosen research approach has been instrumental in reaching the goals set. Only few meal development alliances are identified in the Danish food industry although many actors agree that they have great potential, and many other forms of product development alliances are present. The multidisciplinary and, when relevant, exploratory approach adopted in this thesis has proven useful in providing an evaluation of the potential effects of product development alliances and modularisation in relation to meal solution quality. The broad approach has, in particular, worked well because of the complexity of the challenges facing food producers. This complexity may be reduced, and the solution proposed offers food producers a strategic way forward. In this respect, the tools developed for both research and management would also seem to be very useful.

This research has presented a possible future product development approach for food producing companies. It will be interesting to follow these companies embarking with their partners on a common journey towards improving the match between products and demands, ensuring their own market position in the process.

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Appendix A, questionnaire

This dissertation features selected results from the questionnaire, see section 2.1, 2.4.2 and 5.2. Supplementary background information and an excerpt of results will be presented in this appendix.

A.1 Questionnaire development

The questionnaire was primarily prepared on the basis of literature studies and previous research results. In relation to food trends, information from the media, seminars, etc. was also included. Two persons (a CEO of a smaller company and a key account manager from a medium sized company) tested the questionnaire, which was adjusted on the basis of their feed-back. The questionnaire consisted of four parts:

- Company and informant data (position, size, products, product development activity, vision)
- Food trends (of relevance to product development)
- Meal solutions (sales channels, influence on product development)
- Product development alliances (activity level, partners, formation and success factors)

It took about 20 minutes to fill in the questionnaire.

A.2 Informants

The questionnaire was sent out in the fall of 2007 to all food producing companies in Denmark with more than 10 employees, 266 in all¹. Contact persons with responsibility for product development were identified in all companies. The questionnaire was distributed as an internet survey². One reminder was sent out a month after the first mail.

45 companies participated in the survey. The response rate was 17 %. Some questions were not relevant to all informants, resulting in a lower response rate.

¹ Data from KrakMarkedsdata.

² Using defgo.net

18% of the companies had more than 250 employees, 42% had between 50 and 150 employees and 40% less than 50 employees, reflecting that the food industry is dominated by small enterprises. The participating companies were geographically dispersed and covered all product categories within the food industry. The informants all had managing positions in their companies, either as CEOs or in product development or marketing.

A.3 Excerpt of results

A.3.1 The company

Question: Write at least three words which describe your company's vision, e.g. consumers, process optimisation, low cost, quality, health, food safety, mass production, product development

Results: top five words mentioned (39 informants):

1. Quality, 74%
2. Food safety, 38%
3. Product development, 23%
4. Process optimisation, 21%
5. Consumer / customers, 18%

A.3.2 Food trends

Question: Choose and prioritise the trends you think will have the greatest influence on your company's future product development

Results: Total number of times chosen and first priority (40 informants)

	Total (%)	1st priority (%)
Convenience	80	35
Health	72	35
Quality	67	45
Organic production	55	18
Higher income	42	18
Snacking	40	13
Changing demographics	37	18
An experience	37	28
Other	37	5
Global kitchen	35	13
Local products	35	5
Inspiration	32	15
Social responsibility	32	10

A.3.3 Meal solutions

Question: Choose and prioritise the sales channels you think will experience the greatest growth in sales of meal solutions

Results: Total number of times chosen and first priority (27 informants)

	Total (%)	1st priority (%)
Retail	74	48
Convenience stores	70	48
Schools	67	22
Canteens	56	26
Care for the elderly	44	11
Restaurants	41	15
Transportation	37	4
Hospitals	30	15
Child care	30	4
Other	15	4

Question: Please note how much you agree with the statements

Results: Number of informants respondents who agree or strongly agree on 5-category scale (27 informants)

	Agree / strongly agree (%)
Meal solutions will gain larger market shares	100
There will be a higher demand for higher quality meal solutions	100
There will be a higher demand for more convenient meal solutions	96
There will be a sharpened focus on health in relation to meal solutions	93
There will be a sharpened focus on freshness in relation to meal solutions	81
There will be a sharpened focus on inspiration in relation to meal solutions	70
Consumers will be willing to pay a higher price for meal solutions in the future	60
There will be a sharpened focus on social responsibility in relation to meal solutions	33

Question: Please note how much you agree with the statements

Results: Number of informants respondents who agree or strongly agree ob 5 category scale (27 informants)

	Agree / strongly agree (%)
It is important that the meal solution can be customised to different customers and consumer segments	86
It is important to set goals for the quality of the meal solution at the point of consumption	85
It is important to create a high degree of variation in the meal solutions offered to consumers	82
It is important to consider potential negative and positive interactions between the elements of the meal solution (meat, vegetables, spices, etc.)	74

A.3.4 Product development alliances

Question: Choose and prioritise the most important motivating factors for entering product development alliances

Results: Total number of times chosen and first priority (39 informants)

	Total (%)	1st priority (%)
Potential turn-over	72	49
Meet new market demands	59	28
Low development costs and time	51	13
Knowledge sharing	49	26
Increased product quality	46	23
Flexibility	39	10
Strengthen own brand	38	10
Spin-off projects	36	5
Inimitable products	33	15
Good publicity	23	3
Other	14	3